

Essays on Financial Markets, Inequality and Economic Development

by

Joaquin Blaum

Submitted to the Department of Economics
in Partial Fulfillment of the Requirements for the Degree of

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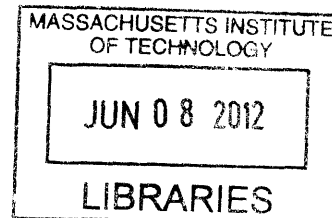
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Abstract

In Chapter 1, I study the effects of wealth inequality on economies where financial markets are imperfect. I exploit the idea that inequality should have a different effect across sectors. Using a difference-in-difference strategy, I show that sectors that are more in need of external finance are relatively smaller in countries with higher income inequality. I then build a model in which sectors differ in their fixed cost requirement, agents face collateral constraints, and production is subject to decreasing returns. A calibrated version of the model is consistent with the documented facts on inequality and cross-sector outcomes. At the calibrated parameters, wealth inequality exacerbates the effect of financial frictions on the economy. Quantitatively, wealth inequality can generate losses of up to 46 percent of per capita income.

In Chapter 2, co-authored with Claire Lelarge and Michael Peters, we explore the ingredients that a model of import behavior should have in order to be consistent with the firm level evidence. We build a model where firms are heterogeneous in their factor neutral productivity, and prices, fixed costs and input qualities are common across firms. Using a comprehensive dataset of French firms, we test the qualitative predictions of such model. The model fares well in describing firm's expenditure across imported varieties, but fails to account for the pattern of expenditure between domestic and foreign inputs. We conclude that a mechanism inducing firm-level heterogeneity in the relative price of domestic varieties is needed to model import demand.

In Chapter 3, I study the effects of financial frictions on the pattern of cross-industry growth rates. I document two facts: (i) externally dependent sectors tend to grow faster along the economy's development path, and (ii) externally dependent sectors grow disproportionately faster in countries with better financial institutions. I argue that financial frictions can account for these facts. I build a dynamic two-sector model in which sectors differ in their liquidity requirement and agents face collateral constraints. Financial frictions generate faster growth in the sector with higher liquidity requirement. I identify conditions under which financial development leads to higher excess growth in the externally dependent sector.

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I dedicate this dissertation to the memory of my grandfather, Jaime D. Blaum, who laid out the foundations of my family's progress and taught me the value of hard work.

Joaquin Blaum
Cambridge, Massachusetts

To Rita, Manuela and Patricia

Chapter 1

Wealth Inequality and the Losses from Financial Frictions

1.1 Introduction

A large body of work in economics studies the effects of financial frictions on economic development. The main channel by which these frictions are thought to affect the economy is the misallocation of resources among production units. In the presence of collateral constraints, valuable resources may not flow to the agents with the highest marginal product. It is well-known that in this context the distribution of wealth becomes relevant for the determination of macroeconomic aggregates. A natural question arises: how does wealth inequality interact with the friction in the financial market? In other words, does wealth inequality tend to exacerbate or help alleviate the effect of financial frictions? The central goal of this paper is to shed light on this question.

Answering this question raises a number of empirical and theoretical challenges. On the empirical side, there are two main problems. First, data on wealth inequality is typically not available for financially developing countries. For this reason, many studies have instead focused on income inequality.¹ Second, it is hard to identify the effects of inequality on the *aggregate* economy. This difficulty is perhaps best exemplified by the literature on income inequality and economic growth, in which different papers have reached opposite conclusions. A fundamental concern in studying the relationship between inequality and aggregate outcomes at the cross-country level is country-specific omitted variable bias. On the theory side, wealth inequality is likely to be associated with multiple effects, many of them playing in opposite directions. For example, with imperfect capital markets and minimum scale requirements, wealth inequality may help some agents start production in sectors with high scale requirements, thus allowing the economy to overcome financial frictions. At the same time, when production is subject to decreasing returns, wealth inequality may induce an inefficient distribution of firm size, with some firms being too large and others too small. The overall impact of wealth inequality on the economy will depend on which of these forces dominates.

To overcome these problems, I propose to use the cross-sectoral variation in firms' reliance on external finance. I exploit the idea that inequality should have a differential effect on sectors that rely more heavily on external finance. On the empirical side, this allows me to better identify the effects of income inequality, albeit at the cross-country cross-industry level. I provide direct evidence of an impact of inequality on the cross-sector structure of production, but I do not identify the aggregate effect of inequality. To make progress, a theory is needed. I build a two-sector model with financial frictions and decreasing returns, in which one sector has larger capital requirements. As expected, the

¹See PEROTTI (1996) and ALESINA AND RODRIK (1994) for examples of papers that have focused on income, rather than wealth inequality, due to the lack of cross-country data on wealth inequality.

effect of wealth inequality on the degree of misallocation depends on parameters. For this reason, I proceed to calibrate the parameters of the model. In particular, I calibrate the technology parameters to match key moments of the US economy. I then test the model by assessing whether it can match the documented facts on income inequality and cross-sectoral outcomes. Finally, having shown that the model is able to come to terms with the cross-sector facts, I use the calibrated model to assess the *aggregate* impact of wealth inequality on the economy. That is, I study the effect of wealth inequality on the degree of misallocation of production resources.

I start by establishing three new facts. First, using the difference-in-difference methodology pioneered by RAJAN AND ZINGALES (1998), I show that industries that rely more heavily on external finance are disproportionately *larger*, in terms of value added shares, in countries with better financial institutions.² Second, and more important for the purpose of this paper, I show that industries that rely more heavily on external finance are *smaller*, in terms of value added shares, in countries with higher income inequality.³ Third, I find significant evidence of *interaction* effects between income inequality and financial development. Perhaps counter-intuitively, the disproportionately negative effect of income inequality on the size of externally dependent sectors is stronger for countries at an intermediate level of financial development. In other words, the negative effect of inequality on value added of externally dependent sectors becomes first stronger and then weaker, as financial development improves. These facts constitute progress with respect to the identification issues explained above. They fall short, however, of shedding light on the aggregate effects of wealth inequality: the facts are on income, not wealth inequality and its effect on cross-sectoral, not aggregate outcomes. Thus, a theory is needed.

I build a two-sector model that features key elements from the literature on financial frictions and economic development. First, I assume that production is subject to decreasing returns to scale. With constant returns, the distribution of firm size would have no impact on aggregate outcomes. Second, I assume that agents face collateral constraints, which ensures that the distribution of wealth, i.e. the distribution of collateral, has an impact on the distribution of firm size, and thus, via decreasing returns, on aggregate output. Third, there are sector-specific fixed costs of operating a firm.⁴ The difference in fixed costs creates a difference in financing needs across sectors, which provides a way to map the model to the data. Fourth, agents face an occupational/sectoral choice.⁵ That is, agents can choose whether to work for a wage or start a firm in either of the two sectors. This assumption is necessary as I only observe data on inequality in income of the entire population in a given country.

In equilibrium, agents sort into the different sectors/occupations according to their wealth, with poor enough agents becoming workers, intermediate agents sorting into the sector with low financial

²This fact is related to the main finding in RAJAN AND ZINGALES (1998). They document that sectors that rely more heavily on external finance grow disproportionately faster in more financially developed countries. My fact is on levels, not growth rates.

³I focus on income inequality due to the lack of data on wealth inequality for a wide range of countries, especially financially developing ones.

⁴The assumption of technological non-convexities is common in the literature, see GALOR AND ZEIRA (1993), BANERJEE AND DUFLO (2005) and BUERA, KABOSKI, AND SHIN (2011).

⁵This assumption, together with decreasing returns to scale, is common in the literature - see Midrigan and Xu (Forthcoming), BUERA AND SHIN (2010), and BUERA, KABOSKI, AND SHIN (2011).

needs, and wealthy enough agents sorting into the sector with high financial needs. This happens because the sector with high financial needs offers a higher price per unit at the expense of a higher fixed cost of entry. This sector will therefore be chosen by agents who plan to produce a sufficiently large amount of output, which, under collateral constraints, are wealthy enough agents.

In the model, wealth inequality affects the economy via three different channels and its qualitative effect on the degree of production efficiency depends on parameters. To understand these effects, as an illustration, consider a mean-preserving poor-to-rich redistribution of one unit of wealth. First, there is a *decreasing returns channel*. To the extent that the relatively poor agent is more severely constrained, such transfer entails a flow of resources away from a high marginal product firm into a low marginal product firm. Second, there is a *capital demand channel*. If the poorer agent is capital constrained while the wealthier is not, the increase in wealth inequality tends to decrease aggregate capital demand. This happens because the poorer agent is borrowing at capacity while the wealthier agent has reached her optimal scale and has no use for the extra funds other than lending. The reduction in aggregate capital demand depresses the interest rate and exacerbates the effects of financial frictions. Finally, there is an *extensive margin channel*: wealth inequality can increase, or decrease, the number of agents that is able to meet the minimum capital requirement of the capital intensive sector. Depending on which of these forces dominates, wealth inequality can either exacerbate or alleviate the degree of misallocation in the economy.

To sort out the quantitative importance of these effects, I calibrate the parameters of the model. The technological parameters are calibrated to match several moments of the US economy in the 1980s. The fixed cost requirement of the high external dependence sector is chosen to match the relative capital intensity across sectors, as documented in the data. I choose the degree of decreasing returns in production - which controls the slope of the profit function - so that the model maps the degree of wealth inequality into the degree of income inequality observed in the US. That is, I make sure that the model does a good job in mapping wealth to income inequality for the US, a country for which both income and wealth data is available.

I test the calibrated model by evaluating whether it can match the facts on financial development, income inequality and cross-sector levels. First, I vary the quality of financial institutions to span a range of external finance to GDP ratios as observed in the data. Consistent with the data, the model predicts that the ratio of external finance to GDP is positively associated with relative value added shares of the sector with high external financial dependence. Second, I impose mean-preserving variation in wealth inequality that is consistent with the observed variation in income inequality. The model's predictions are in line with the documented cross-sectoral relation: higher income inequality is associated with *lower* relative value added, and lower relative output, in the more externally dependent sector. Third, the calibrated model predicts interaction effects between income inequality and financial development that are compatible with the ones documented in the data. Specifically, for a range of low levels of financial development, the model predicts that the negative effect of wealth inequality on relative value added becomes *stronger* as financial institutions improve. The intuition for this effect relies on the capital demand channel. When financial development is low, an increase in inequality is likely to redistribute resources among constrained agents who are borrowing at capacity.

This means that the effect on total capital demand is likely to be small. When financial frictions are less tight, an increase in inequality is likely to shift resources away from constrained entrepreneurs into the hands of unconstrained entrepreneurs, and thus reduce aggregate capital demand. Put differently, the strength of the capital demand channel is increasing in the degree of financial development. At some point, when financial development is sufficiently high and most producers have reached their optimal scale, wealth inequality has no effect on aggregate capital demand. Therefore, the capital demand channel can account for the non-monotone interaction effect found in the data.

I then use the calibrated model to study the *aggregate* effects of increased wealth inequality. Keeping average wealth and the technology parameters fixed at their US levels, I perform mean preserving spreads to the distribution of wealth to span a range of income Gini coefficients as observed in the sample. The main result of the paper emerges: at the calibrated parameters, wealth inequality tends to exacerbate the effects of financial frictions, placing the economy further away from its first best. This happens because inequality shifts resources towards agents with relatively low marginal product of capital (decreasing returns channel), and agents who have reached their optimal scale (capital demand channel). Furthermore, wealth inequality reduces the number of agents that is able to meet the fixed cost and enter the more externally dependent sector (extensive margin channel). In this way, wealth inequality harms production efficiency via the three possible channels. Quantitatively, the losses from wealth inequality can be large. An increase in wealth inequality that leads to an increase in income inequality of 15 points in Gini reduces income per capita by 46%. I show that about a quarter of these losses can be accounted by the extensive margin channel.

Finally, I use the calibrated model to study the losses from financial frictions, keeping the distribution of wealth constant. I find that financial frictions can reduce output per capita by up to 35%.⁶ This number is comparable, in order of magnitude, to the losses from increased wealth inequality. This should not be surprising since collateral constraints, and inequality in the distribution of wealth, both affect the economy via distorting the distribution of firm size.

Related Literature. This paper is related to several literatures in economics. A large empirical literature studies the effects of income inequality on macroeconomic performance.⁷ The standard approach to measure this relationship has been to run a variant of Robert J. Barro's cross-country regression, with inequality added as an independent variable.⁸ As is well-known, this methodology is subject to the econometric problem of omitted-variable bias. A second generation of papers emerged after the development of a new dataset by DEININGER AND SQUIRE (1996), which provides high quality data for a more comprehensive set of countries, with consecutive measurements of income

⁶In comparing this number with the losses found in the literature, an important caveat should be made. The literature typically studies the effect of financial frictions *across steady states* (see BUERA, KABOSKI, AND SHIN (2011), MIDRIGAN AND XU (FORTHCOMING)). That is, the economy is given an infinite amount of time to adjust to the change in financial institutions. In this paper I study the opposite case: I vary the degree of financial frictions while keeping the distribution of wealth constant.

⁷Several papers focus on income, rather than wealth inequality due to lack of data on wealth inequality for a wide range of countries - see PEROTTI (1996) and ALESINA AND RODRIK (1994) for prominent examples.

⁸For examples of this regression, see PEROTTI (1996), ALESINA AND RODRIK (1994), ALESINA AND PEROTTI (1996), and PERSSON AND TABELLINI (1994), among others.

inequality for each country. The panel structure of their dataset allowed researchers to control for time-invariant, unobservable country characteristics, thus helping reduce omitted-variable bias (see FORBES (2000) and LI AND ZOU (1998)). I contribute to this literature by providing an alternative way to identify the effects of income inequality on macroeconomic outcomes. By focusing on the cross-industry effects of income inequality, I am able to include country (and sector) fixed effects and address the issue of country-specific omitted-variable bias.

There is also a vast theoretical literature that studies the effects of inequality on macroeconomic outcomes. Two broad classes of theories predict an effect of the distribution of wealth on economic performance: political economy theories, and models of imperfect capital markets. In the former class of theories, inequality leads - via the political process - to the implementation of redistributive policies which may harm economic growth - see ALESINA AND RODRIK (1994) and PERSSON AND TABELLINI (1994) for prominent examples. In the latter class of theories, the distribution of wealth interacts with the friction in financial markets, and affects the way in which production resources are allocated. Seminal contributions in this area are BANERJEE AND NEWMAN (1993), GALOR AND ZEIRA (1993), GREENWOOD AND JOVANOVIC (1990), PIKETTY (1997), LLOYD-ELLIS AND BERNHARDT (2000) and JEONG AND TOWNSEND (2008), among others. By documenting the differential effect of income inequality on sectors that rely more heavily on external finance, and the interaction effects between financial development and inequality, my paper provides evidence for financial frictions as a channel through which the distribution of wealth matters.

This paper is also related to the quantitative literature that studies the effects of financial frictions on aggregate productivity (JEONG AND TOWNSEND (2007), BUERA AND SHIN (2010), BUERA, KABOSKI, AND SHIN (2011), Midrigan and Xu (Forthcoming), MOLL (2010)). This literature typically considers a dynamic framework in which agents are heterogeneous in wealth and ability, and there are idiosyncratic shocks. In this paper, I consider a stripped-down version of the typical model in this literature. In particular, I propose a static model with a single source of heterogeneity (wealth) and no shocks. I abstract from dynamics and shocks because I take the distribution of wealth as an exogenous primitive of the economy. In other words, the goal of this paper is not to provide a theory of the determinants of the distribution of wealth, but rather to study the effects of exogenous changes in it.⁹ Finally, I abstract from heterogeneity in ability. While it is straightforward to extend the model with ability heterogeneity, the static nature of the model implies that I would need to calibrate the joint distribution of wealth and ability. It is particularly difficult to calibrate the correlation between wealth and ability. To the extent that wealth and ability are positively correlated, the losses from wealth inequality will be smaller. In this sense, the losses reported in this paper should be taken as an upper bound.

⁹In other words, the theory is silent on the underlying cause of the differences in wealth inequality across countries. To the extent that such cause has a direct effect on the degree of misallocation (above and beyond its indirect effect via the degree of inequality), my approach will attribute all of the effect to wealth inequality. On the other hand, making the theory dynamic amounts to providing a specific theory for the distribution of wealth. Thus, in a dynamic context one can study the effect of changes in a underlying parameter (which governs steady state wealth inequality) on the degree of misallocation. This would, however, require assuming that variation in wealth inequality across countries is due to difference in such underlying parameter. In this sense, any dynamic theory will be less general than the static framework.

The theoretical framework used in this paper is closely related to the one in BUERA, KABOSKI, AND SHIN (2011). They consider a two-sector economy in which differences in fixed cost requirements drive differences in external financing needs across sectors. They study the effects of varying the quality of financial institutions, and show that financial frictions reduce productivity disproportionately more in the sector with high financial needs. In this paper, I use a somewhat similar framework to study a different question: the effects of increased wealth inequality, for a given level of financial development. In this sense, the two papers should be viewed as complementary.

This paper is related to the literature on misallocation and aggregate total factor productivity (RESTUCCIA AND ROGERSON (2008), HSIEH AND KLENOW (2009)). I add to this literature by showing that, in the presence of financial frictions, inequality in the distribution of wealth constitutes a source of misallocation that can lower aggregate productivity by up to 46%.

This paper is also related to the quantitative literature on wealth inequality (CAGETTI AND DENARDI (2006), QUADRINI (2000), CASTAÑEDA, DIAZ-GIMENEZ, AND RIOS-RULL (2003)). CAGETTI AND DENARDI (2006) study the role of financial frictions in explaining the high degree of concentration in wealth observed in the US. They ask whether borrowing constraints exacerbate or mitigate the degree of wealth inequality. In contrast, my paper takes the distribution of wealth as a primitive and studies the effects of exogenous changes in inequality on the degree of misallocation resulting from financial frictions.

Finally, this paper is related to the literature on credit market imperfections and international trade. KLETZER AND BARDHAN (1987) and MATSUYAMA (2005) provide theories where financial development is a source of comparative advantage in sectors that are more intensive in external finance. BECK (2003) and MANOVA (2008) show that indeed financial development increases exports disproportionately more in these sectors. While I do not focus on international trade, my model also features financial development as a source of comparative advantage in finance-intensive sectors. I provide evidence that financial development leads to disproportionately higher output and value added shares in sectors with high external financial dependence. More importantly, I emphasize the role of the distribution of wealth as a source of comparative advantage.¹⁰ In this sense, my paper is related to WYNNE (2005) who shows that wealthier nations should produce more in sectors that are more affected by credit market imperfections. In this paper, I focus on a different aspect of the wealth distribution, namely the degree of inequality for a given level of average wealth.

The rest of the paper is organized as follows. Section 1.2 contains the empirical evidence on inequality, financial development and cross-industry outcomes. Section 1.3 outlines the model and Section 1.4 contains the calibration of the technology parameters. Section 1.5 tests the model by assessing whether it can match the cross-sector facts documented in Section 1.2. Section 1.6 studies the aggregate effects of wealth inequality. Finally, Section 1.7 concludes.

¹⁰In the Appendix, I show that my facts on income inequality and cross-industry levels also hold for exports. I show that countries with higher income inequality exhibit disproportionately lower export shares in industries that rely more heavily in outside finance.

1.2 Empirical Evidence

The goal of this section is to provide evidence of the effect of income inequality and financial development on cross-industry levels.¹¹ As a measure of industry level, I use the industry's share in total manufacturing value added. Section 1.8.3 in the Appendix considers output and export shares as alternative measures. I document three facts. First, sectors that rely more heavily on external finance exhibit disproportionately *higher* value added shares in countries with better financial institutions. Second, sectors that rely more heavily on external finance account for disproportionately *lower* shares of total manufacturing value added in countries with higher income inequality. Third, the disproportionately negative effect of income inequality on value added shares of the high external dependence sectors becomes first stronger and then weaker as financial development improves.

To take a first glance at the data, Section 1.2.2 compares average industry value added shares in high vs low external dependence industries, both for high and low income inequality countries. Then, Section 1.2.3 provides cross-country regressions of relative value added in high dependence industries on income inequality, financial development and several controls at the country level. Finally, since the cross-country methodology is subject to country-specific omitted-variable bias, Section 1.2.4 provides *cross-country cross-industry* regressions in the spirit of RAJAN AND ZINGALES (1998) - henceforth RZ. All three types of evidence exhibit consistent results. Subsection 1.8.3 in the Appendix contains robustness checks, including alternative measures of financial development and income inequality.

1.2.1 Data

I use value added data for a sample of 39 countries and 36 ISIC Rev.2 manufacturing industries in 1980. Data on value added across countries and industries is obtained from the Industrial Statistics Yearbook, compiled by the United Nations Statistical Division (1993) - henceforth UNSD. Data on income inequality at the country level is obtained from DEININGER AND SQUIRE (1996). Their database provides data on Gini coefficients and represents a quality improvement over previous datasets in terms of: (i) comprehensive coverage of the population, (ii) comprehensive coverage of income sources, and (iii) the requirement that observations be based on household surveys.

Data on financial development was obtained from the IMF's *International Financial Statistics* (IFS) and the International Finance Corporation's (IFC's) *Emerging Stock Market Factbook*. The leading measure of financial development used is the *capitalization ratio*, defined as the sum of domestic credit plus stock market capitalization over GDP. Stock market capitalization is obtained from the Emerging Stock Market Factbook. Domestic credit is taken from the IFS, as the sum of lines 32a through 32f, excluding 32e. Domestic credit to the private sector is given by line 32d. Section 1.8.3 in the Appendix considers three alternative measures of financial development: (i) the ratio of domestic credit to the private sector plus stock market capitalization to GDP, (ii) the ratio of stock

¹¹I focus on income rather than wealth inequality due to issues of data availability (PEROTTI (1996) and ALESINA AND RODRIK (1994) follow a similar approach). Data on the distribution of wealth across countries is only available for a small set of developed economies - see the Luxembourg Wealth Study Database. In contrast, data for income inequality is available for a wide range of countries, both financially developing and developed.

Australia	Finland	Zimbabwe	Portugal
Banglades	France	Malaysia	Singapore
Belgium	Germany	Mexico	South Africa
Brazil	Greece	Morocco	Spain
Canada	India	Netherlands	Sri Lanka
Chile	Italy	New Zealand	Sweden
Colombia	Japan	Norway	Turkey
Costa Rica	Jordan	Pakistan	UK
Denmark	Kenya	Peru	Venezuela
Egypt	Korea	Philippines	

Table 1: Countries in UNSD Data

market capitalization to GDP, and (iii) the accounting standards. Data on accounting standards is taken from the Center for International Financial Analysis and Research.

The availability of data on financial development and high quality income inequality limits the number of countries that can be included in the sample. The capitalization ratio can be computed for 41 countries in 1980. DEININGER AND SQUIRE (1996) report the Gini coefficient in 1980 for about one third of these countries. I overcome this problem by using measurements of income inequality that are as close as possible to 1980. Table 12 in the Appendix shows the year used for each country in the sample.¹² Finally, I discard countries for which there is no data in the Industrial Statistics Yearbook that is separated by at least 5 years during the 80s.¹³ The final sample consists of 39 countries, which are listed in Table 1.¹⁴

Data on external financial dependence for 36 3-digit ISIC manufacturing sectors during the 1980s is taken from RAJAN AND ZINGALES (1998). They use firm-level data on publicly traded US firms from Compustat (1994) and measure a firm's dependence on external finance as the fraction of capital expenditures that is not financed with internal cashflows from operations. Table 13 in Section 1.8.2 of the Appendix lists the 36 sectors, in order of increasing external financial dependence.

1.2.2 Descriptive Statistics

As a first pass at gauging the effects of income inequality on cross-sector levels, I perform a simple split-sample analysis. I compare average value added shares of low and high external dependence industries in a sub-sample of 20 countries with high, and 19 countries with low income inequality. An industry's value added share is defined as the ratio of nominal value added to total manufacturing value added in the country in 1980. Table 2 contains the results. We see that low income inequality

¹²The adopted criterion implies using, for a few countries, the Gini coefficient for a post-1980 year. A similar issue is present in RZ, who measure stock market capitalization for the earliest year in the 1980's for which data is available. For three African countries (Zimbabwe, South Africa and Kenya), high quality data on income inequality is available only for single year in the early 1990s. I include these observations in the sample, but I show that the results are robust to excluding these three countries.

¹³This is a way to increase the quality of the observations, which is also used by RZ.

¹⁴The final sample coincides with the one used in RZ, except for two countries, Austria and Israel, for which data on income inequality is not available.

countries exhibit similar average industry shares in high vs low external dependence sectors. Countries with high income inequality, however, feature smaller shares in industries with high external dependence. In other words, income inequality is associated with disproportionately lower value added shares in sectors with high external dependence. The diff-in-diff estimate is -1.48%.

Panel B in Table 2 shows that financial development has the opposite effect. Financially developed countries - that is, those with high capitalization ratio - exhibit disproportionately higher shares in externally dependent sectors. The diff-in-diff estimate is 0.82%.

The split-sample averages in Table 2 suggest that financial development and income inequality have opposite effects on industry shares.

Panel A			
	High Inequality	Low Inequality	Difference
High FinDep	2.55 %	3.24%	-0.69 %
Low FinDep	4.05 %	3.26%	0.79 %
Difference	-1.50 %	-0.02 %	-1.48 %
Panel B			
	F. Developed	F.Developing	Difference
High FinDep	3.03 %	2.70%	0.33 %
Low FinDep	3.44 %	3.93%	-0.49 %
Difference	-0.41 %	-1.23 %	0.82 %

Notes: The table shows average industry shares in total manufacturing value added for 1980 for different groups of industries and countries. The 36 manufacturing industries are classified in a group of high external dependence and a group of low external dependence, according to the median level of external dependence. High inequality countries are those with Gini coefficient larger than the median. Financially developed countries are those with capitalization ratio larger than the median.

Table 2: Descriptive Statistics for Industry Shares

1.2.3 Cross-Country Analysis

I now study the effect of income inequality and financial development on relative value added at the country level. I define log relative value added in country k as $lrva_k \equiv \log(va_{Hk}) - \log(va_{Lk})$, where va_{Hk} is nominal value added in sectors with external dependence higher than the median in country k in 1980, and va_{Lk} is similarly defined for industries with external financial dependence lower than the median. I estimate the following model on the cross-section of countries:

$$lrva_k = c + \beta_1 \lambda_k + \beta_2 G_k + \gamma X_k + \epsilon \quad (1)$$

where λ_k is the capitalization ratio in 1980, G_k is the income Gini coefficient in 1980¹⁵, and X_k is a vector of country-level controls including the stock of human capital (defined as years of schooling in the population over 25), per capita income, and indicators of the origin of the legal system (British, French, German, or Scandinavian).

Table 3 reports the results. Columns (1)-(3) show that inequality and financial development have

¹⁵When the Gini coefficient was not available for 1980, the closest possible earlier year was used. See Section 1.8.1 in the Appendix for further details.

different effects on relative levels: while financial development is associated with *higher* relative value added in externally dependent industries, the effect of inequality on relative levels is *negative*. This is consistent with the results of the split-sample analysis of the previous section.

Dep. var.	Log Relative VA in High Dependence Industries		
	(1)	(2)	(3)
Capitalization ratio	0.633** (0.242)		0.593** (0.238)
Gini		-2.098** (0.943)	-2.068** (0.874)
Controls	Y	Y	Y
Observations	39	37	37
R2	0.412	0.393	0.494

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the logarithm of the ratio of total value added in high external financial dependence industries to total value added in low external financial dependence industries in 1980. Both the coefficient estimate and the standard error for the Gini coefficient are multiplied by 100. Controls include the stock of human capital, per capita income and an indicator variable for origin of the legal system (English, French, German or Scandinavian).

Table 3: Cross-Country Regressions for Industry Levels

1.2.4 Cross-Country Cross-Industry Analysis

This section establishes the main empirical results of the paper. I use the difference-in-difference methodology pioneered by RAJAN AND ZINGALES (1998) to identify the differential effect of income inequality and financial development on industry value added shares. I estimate the following specification:

$$\begin{aligned} \log(s_{jk}) = & c + \alpha_j + \alpha_k + \beta_1 ed_j \lambda_k \\ & + \beta_2 ed_j G_k + \beta_3 ed_j \lambda_k G_k + \epsilon_{jk} \end{aligned} \quad (2)$$

where s_{jk} is industry j 's share of total value added in manufacturing in 1980 and ed_j is the level of external financial dependence in industry j . This empirical model includes two double interaction terms and a triple interaction one. Since our interest lies on the interactions between financial development and inequality, a specification including all possible interactions between external dependence at the sector level and income inequality and financial development at the country level is necessary. The advantage of this difference-in-difference approach comes from the inclusion of country and sector fixed effects. I am thus able to address the issue of bias from omitted country-specific and industry-specific variables. Apart from these fixed effects, only RHS regressors that vary with both industry and country are required.

To interpret the estimation of (2), it is useful to consider the difference in log value added shares between a sector with high (H) and a sector with low (L) external dependence, $\log(s_{Hk}) - \log(s_{Lk})$. This log share differential is equal to log relative value added, as defined in Section 1.2.3. Thus,

differencing equation (2) we have that:

$$\frac{\partial lrva_k}{\partial G_k} = (\beta_2 + \beta_3 \lambda_k) \Delta ed, \quad (3)$$

which means that relative value added is decreasing in the level of income inequality as long as $\beta_2 + \beta_3 \lambda_k < 0$. Note that (3) makes clear the presence of interaction effects: if $\beta_3 < 0$, we have that financial development strengthens the negative effect of income inequality on relative value added. Likewise, the effect of financial development on relative value added is given by

$$\frac{\partial lrva_k}{\partial \lambda_k} = (\beta_1 + \beta_3 G_k) \Delta ed \quad (4)$$

Financial development generates an increase in relative value added as long as $\beta_1 + \beta_3 G_k > 0$. If additionally $\beta_3 < 0$, an increase in income inequality weakens the positive effect of financial development on relative value added.

Table 4 contains the results of the estimation of (2). I find that industries with high reliance on external finance account for a *lower* share of total manufacturing value added in countries where the distribution of income is more unequally distributed (see column (2)). Columns (3) and (4) show that these results do not go away when both financial development and inequality terms are included at the same time.¹⁶ Furthermore, I find that industries that are more dependent on external finance account for a relatively higher share of total manufacturing value added in more financially developed countries.

To get a sense of the magnitude of the effects, consider the following calculations. The industry at the 75th percentile of dependence is Machinery (with external dependence of 0.45), while the industry at the 25th percentile is Beverages (with an index of 0.08). The country at the 75th percentile of income inequality is Peru (with a Gini of 49.33), while the country at the 25th percentile is India (with a Gini of 32.14). Setting the level of financial development at the sample mean, the coefficients in column (4) of Table 4 imply that the ratio of value added in Machinery to value added in Beverages should be 16.20% lower in Peru as compared to Pakistan. As for financial development, we have that the country at the 75th percentile of financial development is Canada (with a capitalization ratio of 0.9771), while the country at the 25th percentile is Philippines (with capitalization ratio of 0.4602). Setting income inequality at its sample mean, the coefficients in column (4) imply that the ratio of value added in Machinery to value added in Beverages should be 22.74% higher in Canada as compared to Philippines.

Interaction Effects. An important implication of Table 4 is the presence of interaction effects between income inequality and financial development. Perhaps counter-intuitively, the negative coefficient of the triple interaction term in column (4) implies that the disproportionately negative

¹⁶It should be noted that, in spite of the lack of significance of the double interaction term between inequality and external financial dependence in column (4), the effect of inequality on relative shares is still negative, as the triple interaction term is negative and significant. Also, it should be noted that, at the average level of inequality, the coefficients of column (4) imply a positive effect of financial development on industry shares.

Dep. var.	Log Industry Share in 1980 Manufacturing VA			
	(1)	(2)	(3)	(4)
Ext dep x total cap	1.062*** (0.200)		0.970*** (0.219)	2.581** (1.031)
Ext dep x gini		-2.801*** (0.626)	-2.080*** (0.685)	0.610 (1.772)
Ext dep x total cap x gini				-3.662* (2.149)
Country and Sector FE	Y	Y	Y	Y
Observations	1257	1191	1191	1191
R2	0.544	0.539	0.550	0.552

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the log of an industry's share in total manufacturing value added in 1980. The variable "Ext dep" is a measure of the industry's level of external financial dependence, as constructed by Rajan and Zingales (1998). The variable "total cap" stands for the total capitalization ratio, which is defined as the ratio of domestic credit plus stock market capitalization to GDP. The variable "gini" stands for the income Gini coefficient, taken from Deininger and Squire (1996). The coefficients estimates and standard errors of any term that includes the Gini coefficient were multiplied by 100.

Table 4: Cross-Country Cross-Industry Regressions for Levels

effect of income inequality on value added shares of high external dependence sectors becomes *stronger* when financial development improves. In other words, financial development strengthens the negative effect of income inequality on relative value added. To further investigate this interaction, I run equation (2) on both a sub-sample of financially developing and developed countries. Table 5 contains the results. A comparison of column (3) in Panel A vs B confirms that the negative effect of income inequality is indeed stronger for financially developed countries. However, a comparison of column (4) in Panel A vs B shows that for financially developed countries the negative effect of income inequality weakens with financial development. To summarize, there is evidence of a *non-monotone* interaction effect: when financial development is low, an improvement in financial institutions tends to strengthen the negative effect of income inequality on cross-industry levels; for sufficiently high level of financial development, this effect is reversed.

Panel A - Financially Developing	Log Industry Share in Manufacturing VA			
	(1)	(2)	(3)	(4)
Ext dep x total cap	0.608 (0.485)		-0.217 (0.727)	4.490 (3.008)
Ext dep x gini		-2.477*** (0.766)	-2.702** (1.223)	2.988 (3.692)
Ext dep x total cap x gini				-11.063* (6.042)
Observations	788	788	788	788
R2	0.535	0.539	0.540	0.543
Panel B - Financially Developed	Log Industry Share in Manufacturing VA			
	(1)	(2)	(3)	(4)
Ext dep x total cap	1.085*** (0.319)		1.440*** (0.333)	0.015 (1.851)
Ext dep x gini		-2.294** (1.127)	-3.870*** (1.160)	-8.174 (5.701)
Ext dep x total cap x gini				3.582 (4.523)
Observations	403	403	403	403
R2	0.634	0.642	0.658	0.659

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. A country is classified as financially developing when its ratio of total capitalization is lower than the 60th percentile.

Table 5: Cross-Country Cross-Industry Regressions, for Financially Developing and Developed

1.3 The Model

The goal of this section is to provide a theory to account for the facts on income inequality and financial development documented in the previous section. My approach is to build the simplest theory that can address, both qualitatively and quantitatively, the facts. To do so, I include the following core ingredients in the theory. First, agents are heterogeneous in their wealth holdings. This feature is essential to study the effects of wealth inequality.¹⁷ Second, there are two sectors in the economy. While several of the channels by which inequality affects economic development in the model would also be present in a one-sector economy, multiple sectors are needed to make the theory testable.¹⁸ Third, agents face collateral constraints. This element is necessary to account for the effects of financial development, and its interactions with income inequality, documented above. In the model, collateral constraints imply that the distribution of wealth has an effect on the distribution

¹⁷It is important to note that I abstract from heterogeneity in ability. While it is straightforward to extend the model in this direction, allowing for heterogeneity in ability requires to calibrate the joint distribution of wealth and ability. A particularly problematic moment to calibrate is the correlation between wealth and ability. Furthermore, in comparing the model to the data, I would need to assume that the correlation between wealth and ability is constant across countries.

¹⁸In this paper, I take the view that the relation between financial development, or income inequality, and real per capita GDP at the country level is not well-identified in the data. Instead, I consider the relation between financial development, or income inequality, and *cross-industry* levels to be better identified. This is due to the inclusion of country fixed-effects in the estimation strategy. See Section 1.2 for more details.

of firm size. Fourth, there are decreasing returns to scale in production. This assumption guarantees that the distribution of firm size has an effect on the overall degree of production efficiency. Together with collateral constraints, this element ensures that the distribution of wealth affects the production side of the economy. Fifth, there are sector-specific fixed costs. The presence of fixed costs creates an extensive margin channel for inequality, as changes in the distribution of wealth affect the mass of agents who can afford the fixed cost. Additionally, the difference in fixed costs across sectors provides a natural way to map the theory to the data. The sector with higher fixed cost turns out to be the more externally dependent one. Sixth, there is occupational and sectoral choice. Without this assumption, the distribution of wealth within the different sectors and occupations would become a primitive of the model, and, due to cross-country data limitations, this would complicate the calibration and model testing exercises.¹⁹

Finally, I consider a static model. Abstracting from dynamics means that the contemporaneous distribution of wealth is exogenous. Given the emphasis of the paper on the effects of wealth inequality, this is a natural assumption to make. In this way, I am able to perform comparative statics with respect to the exogenous distribution of wealth and study the effects on the degree of misallocation and various macroeconomic aggregates.²⁰

1.3.1 Basic Environment

I consider an economy with two intermediate sectors ($i = 1, 2$) and one final good sector. The final good is both a consumption good and an input into the production of the intermediates. In turn, the intermediates are used for the production of the final good. The final good is assumed to be the numeraire.

The economy is populated by a unit mass of producer-consumer agents who are endowed with physical capital, or wealth, and labor. I assume that all agents are endowed with the same amount of labor (normalized to unity) and that wealth is the only dimension of heterogeneity among agents. I denote by $G(\omega)$ the distribution of initial wealth. Agents derive utility from consumption of the final good.

At the beginning of the period, agents choose their occupation: they can work for a wage w , or operate a business in intermediate good sector 1 or 2.²¹ For simplicity, it is assumed that they

¹⁹The assumption of occupational and sectoral choice implies that the country-wide distribution of wealth can be recovered from the country-wide distribution of income, which is observable for a wide range of countries - see Sections 1.4 and 1.5 for details. Since data on income distribution at the sector/occupation level is typically not available for a wide range of countries, this assumption makes the calibration of the model possible, without the need of making further assumptions on the between-sector and within-sector distributions.

²⁰This paper does not provide a theory for the distribution of wealth, but rather studies the effects of exogenous changes in it. Explicitly modeling dynamics, i.e. the consumption-savings decision, is equivalent to providing a theory for the distribution of wealth. To map such a dynamic theory to the data, it would be necessary to assume that differences in wealth inequality across countries are driven by variation in some underlying parameter - e.g. the variance of shocks to income. But such an approach would be less general than the one followed in this paper, as it would identify the effect of the underlying parameter, and not of wealth inequality per se, on the degree of misallocation. At the same time, the existing theories for the distribution wealth have a hard time in matching the Pareto shape of the entire wealth distribution - see CAGETTI AND DENARDI (2006) and QUADRINI (2000).

²¹Agents can at most have one occupation. That is, an agent cannot both run a firm and be a worker.

cannot engage in production of the final good. To start a firm in intermediate sector i , agents must pay a sector-specific fixed cost of f_i units of capital. The intermediate sectors are assumed to differ in their fixed cost requirement, with $f_2 > f_1$. As will be clear below, this will imply that sector 2 is the more externally dependent sector. After paying the fixed cost, the agents produce according to the following technology:

$$A_i(k^\alpha l^{1-\alpha})^\nu \quad (5)$$

where k denotes capital (or units of the final good), l denotes labor, ν is the share of payment going to the variable factors - that is, the span-of-control parameter (LUCAS (1978)) -, α is the share of this payment going to capital, and A_i is sector-level productivity. It is assumed that $\alpha, \nu \in (0, 1)$, which means that intermediate producers are subject to diminishing returns to scale. Note that while the factor elasticities in (5) are identical across sectors, sector 2 is in effect more capital intensive due to its higher fixed cost.

Production of the final good is done by a set of competitive firms, who have access to a constant returns to scale technology,

$$\left[\gamma Y_1^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) Y_2^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

where $\gamma \in (0, 1)$, $\varepsilon \in [0, \infty)$ and Y_i denotes quantity of intermediate input i . Note that production of the final good does not require a fixed cost. Final good firms start with no wealth and earn zero profits.

After agents have chosen their occupation, a market for capital rental meets where capital is lent at rate r . As is common in the literature (BUERA, KABOSKI, AND SHIN (2011), MIDRIGAN AND XU (FORTHCOMING), EVANS AND JOVANOVIĆ (1989)), it is assumed that capital loans are due at the end of the period. The crucial assumption is that trade in the capital market is subject to a friction, by which the amount of borrowing is limited by the entrepreneur's net worth. I assume that agents can borrow up to a fraction of their wealth. More precisely, an agent with wealth ω is able to borrow a total of $(\lambda - 1)\omega$, where $\lambda \geq 1$ is a parameter that captures the degree of financial development in the economy. This specification of the borrowing constraint is widely used in literature (BANERJEE AND NEWMAN (2003), BUERA AND SHIN (2010)), and is chosen for tractability reasons. A higher value of λ is associated with better financial markets, with $\lambda = 1$ corresponding to the absence of credit and $\lambda = \infty$ corresponding to perfect capital markets.

Finally, I assume that final good firms are not subject to the financial friction. This assumption is made for simplicity.

1.3.2 Equilibrium

In this section, I study the behavior of entrepreneurs and final good firms. I then define and characterize the equilibrium.

Problem of Entrepreneurs

Entrepreneurs' occupational and production decisions are as follows. First, they must decide whether to work for a wage, or engage in production of intermediate goods. If they become en-

trepreneurs, they need to choose a sector in which to operate, how much output to produce and which combination of inputs to employ.

Assuming, without loss of generality, that all capital is borrowed, the production problem of agent ω in sector i is:

$$\pi_i(\omega) = \max_{k,l} p_i A_i (k^\alpha l^{1-\alpha})^\nu - w l - (r + \delta)(k + f_i) \quad \text{s.t. } k + f_i \leq \lambda \omega$$

where p_i denotes the price of intermediate good i and w denotes the wage rate. Note that I have assumed that the fixed cost and working capital both depreciate at the same rate. The *unconstrained* solution to this problem is given by

$$\begin{aligned} k_i^u &= \left(p_i A_i \nu \left(\frac{1-\alpha}{w} \right)^{\nu(1-\alpha)} \left(\frac{\alpha}{r+\delta} \right)^{1-\nu(1-\alpha)} \right)^{\frac{1}{1-\nu}} \\ l_i^u &= \left(p_i A_i \nu \left(\frac{1-\alpha}{w} \right)^{1-\alpha\nu} \left(\frac{\alpha}{r+\delta} \right)^{\alpha\nu} \right)^{\frac{1}{1-\nu}} \end{aligned}$$

with associated unconstrained profits

$$\pi_i^u = (1-\nu) \left(p_i A_i \nu \left(\frac{\alpha}{r+\delta} \right)^{\alpha\nu} \left(\frac{1-\alpha}{w} \right)^{(1-\alpha)\nu} \right)^{\frac{1}{1-\nu}} - (r+\delta)f_i$$

The solution to the *constrained* problem is given by

$$\begin{aligned} k_i(\omega) &= \min \{ \max \{ \lambda \omega - f_i, 0 \}, k_i^u \} \\ l_i(\omega) &= \left(\frac{p_i A_i \nu (1-\alpha)}{w} \right)^{\frac{1}{1-\nu(1-\alpha)}} k_i(\omega)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}} \end{aligned}$$

Agents with wealth below f_i/λ cannot enter into sector i . This introduces a non-convexity that will play an important role in the analysis. Finally, profits after entry into sector i are

$$\pi_i(\omega) = \left(\frac{1}{(1-\alpha)\nu} - 1 \right) \left(\frac{p_i A_i (1-\alpha)\nu}{w^{(1-\alpha)\nu}} \right)^{\frac{1}{1-(1-\alpha)\nu}} k_i(\omega)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}} - (r+\delta)(k_i(\omega) + f) \quad (6)$$

Each entrepreneur sorts into the occupation/sector that is most profitable to her, with resulting profits before entry of $\pi(\omega) = \max\{w, \pi_1(\omega), \pi_2(\omega)\}$. Output is given by

$$y_i(\omega) = A \left(\frac{1}{w} p_i A (1-\alpha)\nu \right)^{\frac{(1-\alpha)\nu}{1-(1-\alpha)\nu}} k_i(\omega)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}}$$

Final good producer problem

Final good producers, who are not subject to financial frictions, solve the following problem:

$$\max_{Y_1, Y_2} \left[\gamma Y_1^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) Y_2^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} - p_1 Y_1 - p_2 Y_2$$

First order conditions imply:

$$\frac{\gamma}{1-\gamma} \left(\frac{Y_1}{Y_2} \right)^{-\frac{1}{\varepsilon}} = \frac{p_1}{p_2} \quad (7)$$

I normalize the price of the final good to unity which, together with free entry into the final good sector, implies:

$$\left[\gamma^\varepsilon p_1^{1-\varepsilon} + (1-\gamma)^\varepsilon p_2^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} = 1$$

Sorting of agents into occupations and sectors. From now on, I assume $f \equiv f_2 > f_1 = 0$. Also, I will focus on the empirically relevant equilibria with positive production of both intermediates. This requires $p_2 A_2 > p_1 A_1 \geq 0$. The higher return per unit in sector 2 is necessary to compensate for the higher fixed cost of this sector. Furthermore, since labor is essential into the production of intermediate goods, any equilibrium needs to feature $w < \pi_1^u$, which ensures that not all agents prefer working for a wage over entrepreneurship in sector 1. Thus, the equilibrium is characterized by two wealth thresholds, $\hat{\omega}_0$ and $\hat{\omega}$, such that all agents poorer than $\hat{\omega}_0$ become workers, agents with wealth in $(\hat{\omega}_0, \hat{\omega})$ become entrepreneurs in sector 1, and agents with wealth above $\hat{\omega}$ enter sector 2.²² These two thresholds are determined by the following indifference conditions:

$$w = \pi_1(\hat{\omega}_0)$$

$$\pi_1(\hat{\omega}) = \pi_2(\hat{\omega})$$

For given prices, Figure 1 shows the returns to each occupation as a function of wealth.²³ The presence of a higher fixed cost in sector 2 implies that wealthy individuals have a comparative advantage in this sector. Intuitively, the decision of entering sector 2 instead of sector 1 is equivalent to the payment of a fixed cost in exchange for a higher (effective) price per unit. Such decision is profitable for a sufficiently large volume of production, which, under borrowing constraints, happens for wealthy enough entrepreneurs.

It is important to note that agents with sufficiently low wealth ($\omega < f/\lambda$) are not able to enter sector 2, so that their occupational choice is restricted to working for a wage vs entrepreneurship in sector 1.

Definition. Given a distribution of wealth $G(\omega)$, an equilibrium with positive production of both intermediates consists of prices (p_1, p_2, r, w) and wealth thresholds $(\hat{\omega}_0, \hat{\omega})$ such that:

1. Marginal agents are indifferent:

$$w = \pi_1(\hat{\omega}_0)$$

$$\pi_1(\hat{\omega}) = \pi_2(\hat{\omega})$$

²²The prediction that wealthier individuals sort into entrepreneurship has empirical support. EVANS AND JOVANOVIĆ (1989), EVANS AND LEIGHTON (1989), HOLTZ-EAKIN, JOULFAIAN, AND ROSEN (1994) show that, in the US, wealth affects positively the probability that individuals become entrepreneurs. BLANCHFLOWER AND OSWALD (1998) provide similar evidence for the United Kingdom. HURST AND LUSARDI (2004) show that this relationship is non-linear, with wealth having a positive effect on the propensity to own a business only at the top of the wealth distribution.

²³Note that for wealth values below f/λ profits in sector 2 are not defined.

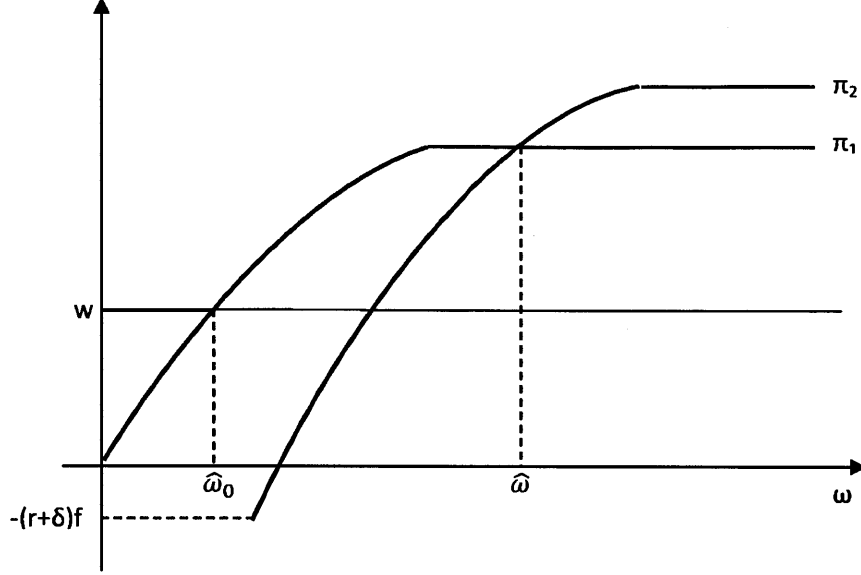


Figure 1: Occupation and Sector Sorting

2. Capital market clears:

$$\int_{\hat{\omega}_0}^{\hat{\omega}} k_1(\omega) dG(\omega) + \int_{\hat{\omega}}^{\infty} (k_2(\omega) + f) dG(\omega) = \mathbb{E}[\omega] \quad (8)$$

3. Labor market clears:

$$\int_{\hat{\omega}_0}^{\hat{\omega}} l_1(\omega) dG(\omega) + \int_{\hat{\omega}}^{\infty} l_2(\omega) dG(\omega) = G(\hat{\omega}_0) \quad (9)$$

4. Final good producers' optimality:

$$\int_{\hat{\omega}_0}^{\hat{\omega}} A_1 k_1(\omega)^{\alpha\nu} l_1(\omega)^{(1-\alpha)\nu} dG(\omega) = \left(\frac{\gamma}{1-\gamma} \frac{p_2}{p_1} \right)^\varepsilon \int_{\hat{\omega}}^{\infty} A_2 k_2(\omega)^{\alpha\nu} l_2(\omega)^{(1-\alpha)\nu} dG(\omega) \quad (10)$$

5. Zero profits in final good:

$$\left[\gamma^\varepsilon p_1^{1-\varepsilon} + (1-\gamma)^\varepsilon p_2^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} = 1 \quad (11)$$

The equilibrium prices and wealth thresholds completely characterize production in the economy, for a given distribution of wealth.

Implicit in this definition is the *extensive margin* constraint that $\hat{\omega} \geq f/\lambda$.²⁴ This constraint

²⁴This constraint is implicit in condition (1) of the equilibrium definition, as $\pi_2(\hat{\omega})$ is not defined for $\hat{\omega} < f/\lambda$.

requires that the mass of agents allocated to sector 2 in equilibrium does not exceed the mass of agents that are wealthier than the *effective fixed cost*, f/λ . It turns out that in an equilibrium with positive production of both intermediate goods this constraint never binds (i.e. $\hat{\omega} > f/\lambda$). This follows directly from the fact that $\pi_1(f/\lambda) > 0 > -(r + \delta)f = \pi_2(f/\lambda)$. Intuitively, it is never socially optimal to assign the agent with wealth exactly equal to f/λ to sector 2, since he would produce no output and incur in a cost of f units of capital.

Agent ω 's end-of-period wealth is given by:

$$(1 + r)\omega + \max\{w, \pi_1(\omega), \pi_2(\omega)\}$$

On the other hand, agent ω 's income is given by:

$$i(\omega) = r\omega + \max\{w, \pi_1(\omega), \pi_2(\omega)\} \quad (12)$$

This equation will play an important role in the coming analysis.

1.3.3 Effects of Wealth Inequality

The main purpose of this paper is to study the effects of increased wealth inequality on macroeconomic aggregates. In the model, the presence of financial frictions implies that the distribution of wealth affects the allocation of productive resources, and thus has an impact on aggregate production. But what is the nature of this link? Does a more unequal distribution of wealth lead to higher or lower production efficiency?

To think about this question, it is useful to consider three channels through which higher wealth inequality affects the economy. Consider a simple example in which a unit of capital is redistributed from a poor and constrained agent to a wealthier, not necessarily constrained agent. First, there is a *decreasing returns* channel. Since the wealthy agent is operating at a bigger scale, her marginal product of capital is lower than that of the poor-constrained agent. Thus, a poor-to-rich redistribution of capital will decrease output.²⁵ To see this more formally, consider average output in sector 1:

$$\frac{1}{G(\hat{\omega}_0) - G(\hat{\omega})} \int_{\hat{\omega}_0}^{\hat{\omega}} y_1(\omega) dG(\omega) = \frac{1}{G(\hat{\omega}_0) - G(\hat{\omega})} \int_{\hat{\omega}_0}^{\hat{\omega}} A \left(\frac{1}{w} p_1 A (1 - \alpha) \nu \right)^{\frac{(1-\alpha)\nu}{1-(1-\alpha)\nu}} k_1(\omega)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}} dG(\omega)$$

Since $k_1(\omega)$ is a concave function of wealth, and $\alpha, \nu \in (0, 1)$, output $y_1(\omega)$ is also a concave function of wealth. Thus, for given prices and wealth thresholds, any mean preserving spread to the distribution of wealth of agents in sector 1²⁶ will reduce average output in this sector. Note that this is a partial equilibrium effect, as prices and wealth thresholds are kept constant.

Second, there is a *capital demand* channel. If the two agents are constrained entrepreneurs, the linearity of the borrowing constraint implies that a redistribution of wealth will have no effect on capital demand. If the wealthier agent has reached the optimal scale and the poorer has not, then

²⁵For simplicity, I focus on the case where both entrepreneurs produce in the same sector.

²⁶That is, a mean preserving spread to $\frac{G(\omega)}{G(\hat{\omega}_0) - G(\hat{\omega})}$.

a poor-to-rich redistribution of wealth between the two entrepreneurs will decrease capital demand. This is because the richer agent has no use for the extra unit of capital other than lending, but the poor agent is at her maximum borrowing capacity. Figure 2 depicts the capital demand channel. To see this effect more formally, consider total capital demand for the case in which all agents in sector 1 are constrained²⁷, $\int_{\hat{\omega}_0}^{\infty} h(\omega) dG(\omega)$, where $h(\omega) = \min\{\lambda\omega, k_2^u + f\}$ is capital demand of agent ω , irrespective of her sector. Since $h(\omega)$ is a concave function of wealth, any mean preserving spread to the distribution of wealth among entrepreneurs will reduce total capital demand.²⁸ However, we can also have a situation where the wealthier agent is constrained while the poorer one is not.²⁹ Figure 3 depicts this situation. In this case, a poor-to-rich redistribution of wealth between the two agents will increase capital demand. Formally, the capital demand function is not globally concave, and a mean preserving spread can result in higher aggregate capital demand. Finally, if the relatively poor agent is a worker while the wealthier one is a constrained entrepreneur, aggregate capital demand also increases.

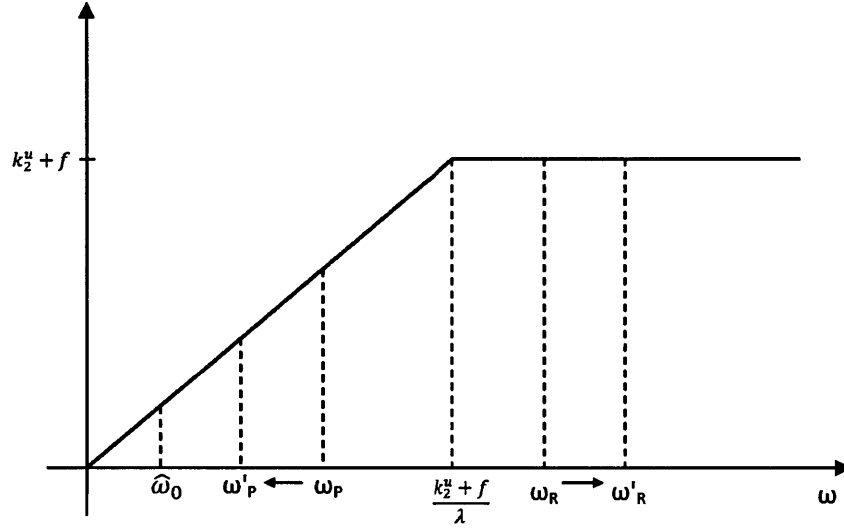


Figure 2: Wealth Inequality and the Capital Demand Channel

²⁷This happens whenever $k_1^u/\lambda \geq \hat{\omega}$.

²⁸A reduction in capital demand, and the associated reduction in labor demand, harm the economy by depressing the interest rate and the wage. The depressed interest rate and wage lead to an excessive amount of entrepreneurship, as well as to an inefficiently high scale of production units. See Section 1.4 for more details.

²⁹This can happen when some entrepreneurs in sector 1 are not constrained.

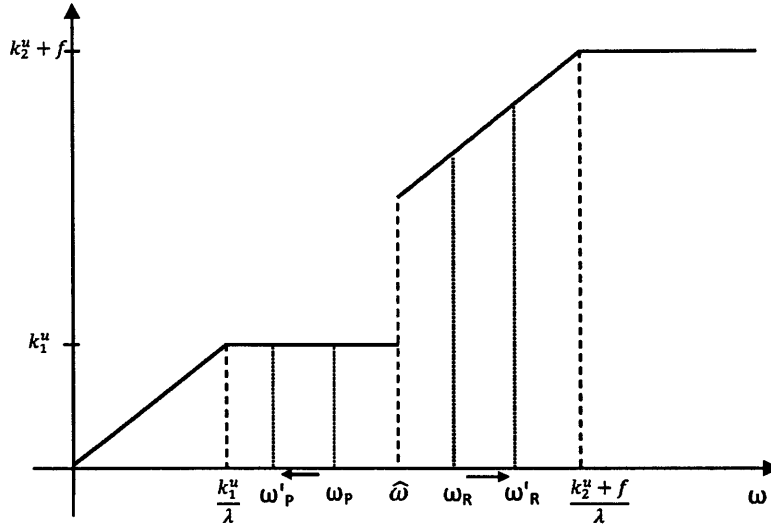


Figure 3: Wealth Inequality and the Capital Demand Channel, II

Third, there is an *extensive margin* effect by which inequality can increase or decrease the mass of agents below the effective fixed cost, f/λ . In our two agents example, suppose that the wealthier agent is unable to enter sector 2 (i.e. $\omega < f/\lambda$), and that the first best features a higher number of production units in sector 2. In this case, a poor-to-rich redistribution of wealth can result in higher entry into sector 2, and thus higher overall efficiency in production. The case in which the poor-to-rich redistribution places more agents below the threshold f/λ is also possible and would exacerbate the effect of financial frictions.

The overall effect of wealth inequality on production efficiency depends upon which of these effects dominates. This, in turn, depends on the specific values of the parameters of the model. If the effective fixed cost is high and/or decreasing returns are not too strong (high f/λ and high ν), then it is likely that the extensive margin effect dominates and inequality is beneficial for the economy. When the fixed cost is relatively low and/or decreasing returns are strong, inequality will most likely harm the economy. To assess the strength of each of these effects and the overall impact of inequality, Section 1.4 proceeds to calibrate the parameters of the model.

1.4 Calibration

The goal of this section is to calibrate the technology parameters of the model. I choose these parameters to match several key moments of the US economy in the 1980s. I use the US to identify the technology parameters because this country was used to construct the sector-level measure of external financial dependence used in Section 1.2.³⁰ To calibrate these parameters, I will also need to calibrate the distribution of wealth and the quality of financial institutions for the US. Note however that, when studying the effects of inequality and financial development, the next two sections will not use the financial and wealth distribution parameters estimated in this section, but rather calibrate these parameters from the sample of countries used to establish the facts in Section 1.2. In short, I identify the technological parameters from the US and the non-technological parameters from the countries in the sample.

I start by assuming that the distribution of wealth is Pareto, that is:

$$G(\omega) = 1 - \left(\frac{\omega_{min}}{\omega}\right)^\theta \text{ for } \omega \geq \omega_{min}$$

where $\theta > 1$ is the shape parameter and ω_{min} is the scale parameter. This assumption is made for two reasons. First, this distribution turns out to be a good approximation for the upper tail of the wealth distribution (see PARETO (1897), KLASS et al. (2006)). In Section 1.8.5 of the Appendix I provide evidence for this statement using Survey of Consumer Finances data for the US. Second, the Pareto distribution is conveniently parametrized to study changes in inequality. The scale parameter controls the average level of wealth, which is equal to: $E[\omega] = \theta/(\theta - 1)\omega_{min}$. The shape parameter controls the degree of wealth inequality in the economy. Specifically, a lower value of θ generates a uniform decrease in the Lorenz curve - that is, it generates a new distribution of wealth that is Lorenz dominated. This increase in wealth inequality is fully captured by the wealth Gini coefficient, which is given by:

$$Gini = \frac{1}{2\theta - 1}$$

The model has 8 technological parameters $(\alpha, \nu, A_1, A_2, f, \gamma, \varepsilon, \delta)$, 1 parameter characterizing the quality of financial institutions (λ) , and 2 parameters characterizing the distribution of wealth (ω_{min}, θ) . I calibrate these parameters so that the model matches several relevant moments of the US economy in 1980. I take the annual depreciation rate to be $\delta = 0.06$, a standard value in the literature.

I assume throughout the paper that there are no productivity differences across sectors³¹,

$$A_1 = A_2 = A$$

This assumption allows me to fully focus on differences in capital intensity across sectors. Moreover,

³⁰Note that I have not included the US in the sample of countries used to establish the cross-sector facts of Section 1.2.

³¹Other papers in the literature make similar assumptions. For example, BUERA, KABOSKI, AND SHIN (2011) assume the distribution of talent to be symmetric across sectors.

to identify differences in productivity across sectors I would need data on sectoral prices, p_1 and p_2 , which the UNSD data does not provide. This parameter can be normalized to unity without loss of generality.

The calibration procedure is as follows. I start by calibrating the wealth distribution parameters (ω_{\min}, θ) to match the mean and the Gini coefficient of the US wealth distribution. I then estimate the elasticity of substitution between the two intermediate sectors, ε , from a time series regression of relative values on relative quantities for the US. I then calibrate the remaining 4 technological parameters (γ, α, ν, f) and the quality of financial markets parameter (λ) to match the following 5 moments of the US economy in 1980: (i) the share of payments to capital in manufacturing GDP, (ii) the share of high externally dependent sectors in total manufacturing value added, (iii) relative capital per workers across sectors, (iv) the income Gini coefficient, and (v) the ratio of external finance to GDP. While these 5 parameters are simultaneously chosen to match the 5 moments, it is helpful to associate one parameter to each moment.³²

As is typical in calibrations of the neo-classical growth model, we can think of α as controlling the share of payments to capital in manufacturing GDP,

$$rE[\omega]/Y \quad (13)$$

It should be noted that, since the model has borrowing constraints and fixed costs, the share of payments to capital will not be exactly given by α , as in the frictionless model without fixed costs. In particular, the capital share can be lower than the value of α .

Consider now moment (ii). Since the intermediate goods are produced with only capital and labor, and do not require any further intermediate goods, we can interpret $p_2 Y_2$ as value added in the high external dependence sector. We can think of $1 - \gamma$ as controlling the share of the externally dependent sector in manufacturing GDP, $p_2 Y_2 / Y$. This is exactly true for the case in which technology in the final good sector is Cobb-Douglas - that is, $\varepsilon = 1$.

The third moment, relative capital per worker across sectors, identifies the fixed cost in the high external dependence sector, f . If the fixed cost was zero, the model would predict that capital intensities should be equalized across sectors. A positive fixed cost makes sector 2 more capital intensive, in the sense that $(k_2 + f)/l_2 > (k_1/l_1)$. In partial equilibrium, a higher fixed cost trivially increases the relative capital labor ratio. In general equilibrium, however, prices and thresholds change so that a higher fixed cost may have a non-monotone effect on relative capital intensity across sectors.³³ At the calibrated parameters, this relationship is increasing.

The span of control parameter, ν , is chosen to generate a realistic level of inequality in the

³²Moments (i) and (iii) are both related to the degree of capital intensity in production. Moment (i) affects both sectors equally, while moment (iii) is included to get at the difference in capital intensity across sectors.

³³For given prices, a higher fixed cost tends to increase capital demand, as unconstrained producers in sector 2 will demand the same amount of working capital and a higher amount of capital for the fixed cost. Note that the constrained agents in sector 2 demand the same amount of capital, as $k_2 + f = \lambda\omega$. However, these agents will use less working capital, k_2 , when the fixed cost is higher, so that labor demand falls. These effects tend to increase the interest rate and decrease the wage. The higher fixed cost has a negative direct effect on sector 2 profits, so that some agents flow to sector 1. This tends to increase p_2 and decrease p_1 . A constrained agent in sector i produces at the following capital

distribution of income. In other words, the model generates a mapping between the exogenous wealth distribution and the endogenous income distribution, and this mapping is crucially affected by ν . To see this, note that agent ω 's income is given by

$$i(\omega) = r\omega + \max\{w, \pi_1(\omega), \pi_2(\omega)\} \quad (14)$$

For given prices, a higher ν leads to a steeper profit function $\pi_i(\omega)$ in both sectors. To see this, note that the profit function becomes a less concave function of wealth when ν is higher - see equation (6).³⁴ Furthermore, an increase in ν leads to a higher interest rate, which also tends to increase income inequality. Finally, an increase in ν leads to a lower wage and a higher mass of workers, so that income inequality is further increased.

The parameter governing the quality of financial institutions, λ , is chosen to match the external finance to GDP ratio. A higher λ naturally leads to more borrowing, as poor-constrained agents expand their demand for capital.

Distribution of Wealth in the US. The assumption that wealth is Pareto distributed implies that only two moments of the US distribution of wealth are required for its calibration: average wealth and the wealth Gini coefficient. The latter moment allows me to identify the shape parameter, θ , and the former moment then pins down the scale parameter, ω_{min} . I use data from the 1983 Survey of Consumer Finances (SCF) to characterize the distribution of wealth in the US. Because household wealth is highly skewed, the upper tail of the distribution is often underrepresented in survey data. The advantage of the SCF data is that it provides a high-income supplement, which is taken from the Internal Revenue Service's Statistics of Income data.³⁵ Table 6 shows values for average wealth and the wealth Gini coefficient for the entire population of US households. These values imply $\theta^{US} = 1.1412$ and $\omega_{min}^{US} = \$14,813.88$.

to labor ratio - including fixed costs:

$$(\lambda\omega)^{\frac{1-\nu}{1-(1-\alpha)\nu}} \left(\frac{w}{p_2 A (1-\alpha)\nu} \right)^{\frac{1}{1-(1-\alpha)\nu}}$$

Since p_2 increases and p_1 decreases, the capital labor ratio of constrained agents tends to decrease by more in sector 2. However, wealth thresholds also change: $\hat{\omega}$ increases, so that sector 2 firms are larger on average - this tends to increase the capital labor ratio in sector 2. At the same time, $\hat{\omega}_0$ also increases. Thus, the average size of firms in sector 1 can move in either direction. As for unconstrained agents, the increase in the relative price of capital tends to decrease k/l by same proportion in both sectors - in fact, unconstrained k/l ratios are equalized across sectors. But sector 2 agents have a higher fixed costs, which tends to increase their unconstrained total capital labor ratio.

³⁴Consider revenue net of labor costs, that is, the first term of the profit function for a constrained entrepreneur:

$$\left(\frac{1}{(1-\alpha)\nu} - 1 \right) \left(\frac{p_i A_i (1-\alpha)\nu}{w(1-\alpha)\nu} \right)^{\frac{1}{1-(1-\alpha)\nu}} (\lambda\omega)^{\frac{\alpha\nu}{1-(1-\alpha)\nu}}$$

It is easy to see that the rate of growth of this term with respect to wealth depends on the exponent $\frac{\alpha\nu}{1-(1-\alpha)\nu}$, which is increasing in ν .

³⁵See WOLFF (1999) for a comparison among 3 household surveys which report wealth: the SCF, the Bureau of the Census' Survey of Income and Program Participation, and the Institute for Social Research's Panel Survey of Income Dynamics.

	Average Wealth	Wealth Gini
All US households	\$119,724	77.98

Notes: Data from the US Survey of Consumer Finances for 1983. Both the normal and the high income sample are included. Wealth (net worth) is given by variable B3324, which is defined as gross assets excluding pensions plus total net present value of pensions minus total debt (B3305 + B3316 - B3320).

Table 6: Moments of Wealth Distribution, US 1983

Measurement of Other US Moments. I measure moments (i)-(v) in the data using the following sources. The aggregate capital share is set at 0.33, a standard value in the literature. For moment (ii), I use value added data for the US in 1980 from UNSD. I classify the 36 3-digit ISIC sectors into two groups, according to external financial dependence.³⁶ I find that high external dependence sectors account for 64.7% of total manufacturing value added.³⁷ Relative scales across sectors (both in terms of labor, l_2/l_1 , and in terms of capital, $(k_2 + f)/k_1$) are estimated from the 1987 US Economic Census, which provides detailed industry data at the 4-digit SIC sector level. I measure the labor input as the number of employees per establishment and the capital input as the (beginning of year) gross value of assets per establishment. I classify the approximately 460 sectors into two groups, according to their level of external financial dependence. To do so, I replicate the measure of external financial dependence in RAJAN AND ZINGALES (1998) at the 4-digit SIC level using firm-level data from COMPUSTAT for the 1980-1990 period. Table 7 summarizes the capital and labor demands in the high and low external dependence sectors.

	Employees per Establishment	Value of Assets per Establishment
Low External Dependence	48	1.72M
High External Dependence	50	2.70M

Notes: The number of employees per establishment and the beginning of year gross value of assets per establishment are taken from the 1987 Economic Census at the 4-digit SIC level of disaggregation. The 460 sectors are classified into two equally sized groups of high external dependence and low external dependence sectors, where the sectoral measure of external dependence is computed as in Rajan and Zingales (1998). To average the different variables across sectors (within each of the two groups), sectors are weighted according to the number of establishments they have. The letter M stands for million of US dollars.

Table 7: Labor and Capital Across Sectors

We see that the labor input is larger in the high external dependence group of sectors, but the difference is fairly small. In contrast, the capital input - as measured by the total value of assets - is 1.56 times larger in the high external dependence group of industries. This implies that externally dependent sectors have a higher capital-labor ratio and that the ratio of capital intensity across sectors is approximately 1.5. This feature of the data is key to the identification of the fixed cost.

³⁶For a list of the 36 manufacturing sectors, ordered by external financial dependence, see Table 13 in Section 1.8.2 of the Appendix.

³⁷As a robustness check, I also estimate this moment with NIPA data (which uses the NAICS system), and find a value of 59.14%.

The Gini coefficient for the distribution of income in the US is taken from DEININGER AND SQUIRE (1996), which in turn use data from the Census Bureau. I take the value of the income Gini coefficient for 1980, which equals 35.2.

I define the ratio of external finance as the sum of domestic credit and stock market capitalization over GDP. This is the leading measure of financial development used in Section 1.2. I use the external finance to GDP ratio of Singapore, which is the most financially developed country in the sample in 1980, with a ratio of 1.9624.

Elasticity of substitution between intermediates. A remaining parameter in the calibration is the elasticity of substitution between intermediates, ε . Recall that the calibration of α, ν, γ, f and A outlined above was conditional on a value of ε . Following ACEMOGLU AND GUERRIERI (2008), I estimate the elasticity of substitution using equation (7) and exploiting the time variation in relative value added and relative quantities. In particular, equation (7) implies the following relation between relative value added and relative quantities across sectors:

$$\log \left(\frac{p_2 Y_2}{p_1 Y_1} \right) = \log \left(\frac{1 - \gamma}{\gamma} \right) + \frac{\varepsilon - 1}{\varepsilon} \log \left(\frac{Y_2}{Y_1} \right) \quad (15)$$

The UNSD data does not provide a measure of Y_2/Y_1 that is comparable across countries for a given point in time - as PPP sector prices are not available. However, the UNSD data does provide quantity indices, i.e. value added in constant prices, that capture movements in Y_2/Y_1 over time for a given country. By taking logs, any term related to constant prices is placed in the time-constant term of the regression.

I use data for the US for the period between 1967 and 1991, taken from the UNSD. I aggregate the 36 ISIC sectors into two groups of industries according to their level of external dependence. I then sum value added across all industries within each group to obtain total value added in high and low external dependence industries. I use the index of industrial production provided by the UNSD data to approximate for quantities. To average across sectors within a group, I weight each industry by its share in the group's total value added. Table 8 contains the results. The estimated coefficient for relative quantity implies a value of $\varepsilon = 3.1142$.

Dep. var.	Relative Value Added
Constant	1.1096*** (0.1628)
Relative quantity	0.6789*** (0.1626)
Observations	25
R2	0.4775
Implied ε	3.1142

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Table 8: Estimation of ε

Results for the Calibration of Technology Parameters. Table 9 summarizes the results of the calibration of the technology parameters. In the next two sections, I will assume that the technology parameters are common to all countries in the sample. I will also assume that all countries have the same level of average wealth, which I set at the US value in 1980.

Target Moment	Data	Parameter
Share of Ext.Dep. Sectors in Manufacturing VA	0.647	$\gamma = 0.4262$
Share of Capital in Manufacturing GDP	0.33	$\alpha = 0.5855$
Relative Capital Intensity in Ext.Dep. Sectors	1.50	$f = \$55,280$
Income Gini	35.2	$\nu = 0.7153$
External Finance to GDP ratio	1.9624	$\lambda = 3.0790$

Notes: “Ext. Dep.” stands for externally dependent sectors. In the data, the 36 manufacturing sectors are classified into two groups according to their level of external financial dependence, as measured by Rajan and Zingales (1998).

Table 9: Calibration of Technology Parameters

Effects of Financial Frictions. How does the calibrated economy compare to the first best? In a frictionless economy, the equilibrium is characterized by the mass of producers in each sector/occupation, as all firms within each sector are identical. Section 1.8.4 in the Appendix contains a definition of the equilibrium in the first best economy. Table 10 shows selected equilibrium outcomes for the calibrated economy and the first best. Both economies share the same technology and distribution of wealth parameters. By depressing capital and therefore labor demand, financial frictions tend to depress the interest rate. The economy shifts its production pattern towards the less capital intensive sector. The depressed interest rate leads to higher profits and this results in an excessive amount of entrepreneurship in the economy with frictions. The presence of a fixed cost, together with financial frictions, results in too many firms in sector 1 and too few in sector 2. Firms in sector 1 are on average too small relative to the first best size, while firms in sector 2 are on average too large. This distortion in firm size follows from the combination of the different price effects. The depressed interest rate induces firms in both sectors to choose a higher scale. In sector 2, the higher price reinforces the increase in scale. In sector 1, the effect of the lower price tends to dominate the interest rate effect, and average scale is lower.

The Wealth Inequality - Income Inequality Mapping. In the next sections, I study the effects of mean-preserving variation in wealth inequality on the economy. Since wealth inequality is not observable in the UNSD sample of countries, I will compare the model and the data on the income inequality dimension. Thus, the wealth inequality - income inequality mapping is of crucial importance. Figure 4 depicts this mapping. The technology parameters are set at their calibrated values - see Table 9. Financial development is set at the level of the median country.³⁸ I perform mean preserving spreads to the initial distribution of wealth, keeping total wealth constant at the level of

³⁸This is a level of λ that generates an external finance to GDP ratio as in the median country in the sample. See Section 1.5 for details on how the calibration of $(\lambda, \theta, \omega_{min})$ is done for the median country.

	Calibrated	First Best
Interest Rate	0.0401	0.0876
Wage	\$19,813	\$19,517
Price 1	0.4640	0.4822
Price 2	0.5421	0.5326
Mass Workers	0.5382	0.5649
Mass Sector 1	0.2564	0.1781
Mass Sector 2	0.2054	0.2570
GDP	\$35,970	\$37,188
Average Capital Sector 1	\$124,502	\$194,514
Average Capital Sector 2	\$372,215	\$275,834
Rel. Output Sector 2	1.5763	1.8522

Notes: The table shows equilibrium outcomes for both the model with frictions calibrated to the US and the first best economy. For both economies, the technology parameters are set according to Table 9 and the wealth distribution is calibrated to the US as described in the previous section.

Table 10: Calibrated Economy vs First Best

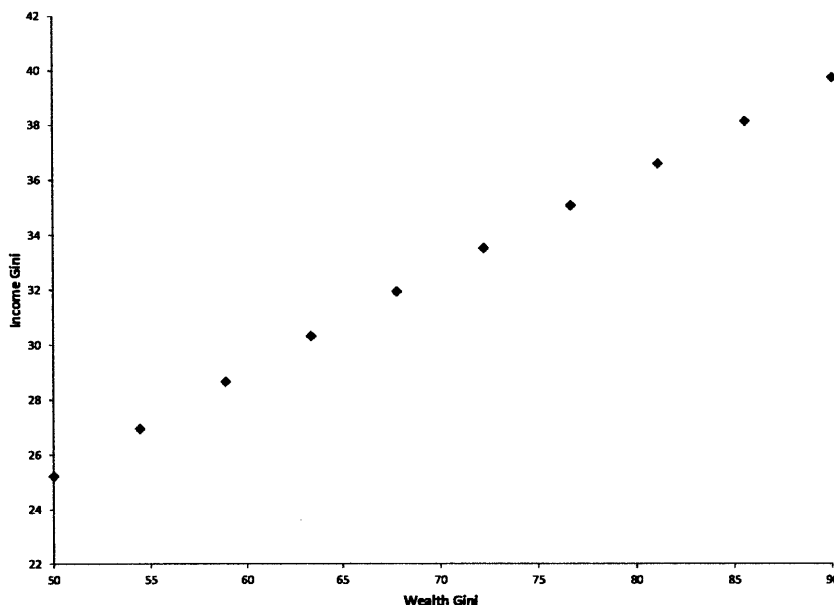
the US in the 1980s. Figure 4 shows that the model generates an upward sloping relationship between wealth and income inequality. In partial equilibrium, such positive relation is straightforward. In general equilibrium, however, an upward sloping relation is not granted. As explained below, wealth inequality tends to decrease both the interest rate and the wage, to decrease the price of good 1, and to increase the price of good 2. These price changes tend to make profits a steeper function of wealth, thus increasing income inequality. At the same time, the lower interest rate gives less importance to interest income, $r\omega$, a term that tends to transmit wealth inequality to income inequality. It turns out that at the calibrated parameters, the latter effect is not dominant.

1.5 Model Testing

The goal of this section is to bring the model to the data. To assess its performance, I evaluate whether the calibrated model can match the cross-sector facts documented in Section 1.2. Keeping the technology parameters fixed, I impose variation in the degree of wealth inequality (or financial development) and assess whether the calibrated model generates a relation between income inequality (or the external finance to GDP ratio) and cross-sector levels that is qualitatively and quantitatively similar to the one documented in Section 1.2. I find that the model can account for the cross-sector facts of Section 1.2.

An important issue arises in performing this exercise: the need to identify a realistic range of values for the degree of inequality in the distribution of wealth. Recall that due to the lack of wealth data across countries the empirical results in Section 1.2 involved inequality in the distribution of income, not wealth. I overcome this problem by finding a range of values for wealth inequality that generates, through the model, income Gini coefficients as observed in the sample. In other words, I use the model to map *observed* income inequality into *unobserved* wealth inequality.

Throughout this section, I keep average wealth and the technology parameters fixed at their US



Notes: The figure plots the income Gini coefficient generated by the model for various levels of exogenous wealth inequality. Total wealth is kept constant. The model is evaluated at the calibrated parameters, and the level of financial development of the median country.

Figure 4: Wealth Inequality - Income Inequality Mapping

values - as calibrated in the previous section. The remaining parameters - those controlling the distribution of wealth, (ω_{min}, θ) and the quality of financial institutions (λ) - will be varied to study the effects of inequality and financial development. To study each of these phenomena separately, it is useful to calibrate $(\omega_{min}, \theta, \lambda)$ to generate an external finance to GDP ratio and an income Gini coefficient as observed for the *median* country in the UNSD sample. The median country has a capitalization ratio of 0.6957 and an income Gini coefficient of 38. This calibration yields $\theta = 1.10$, $\omega_{min} = \$10,884$ and $\lambda = 1.164$ for the median country.

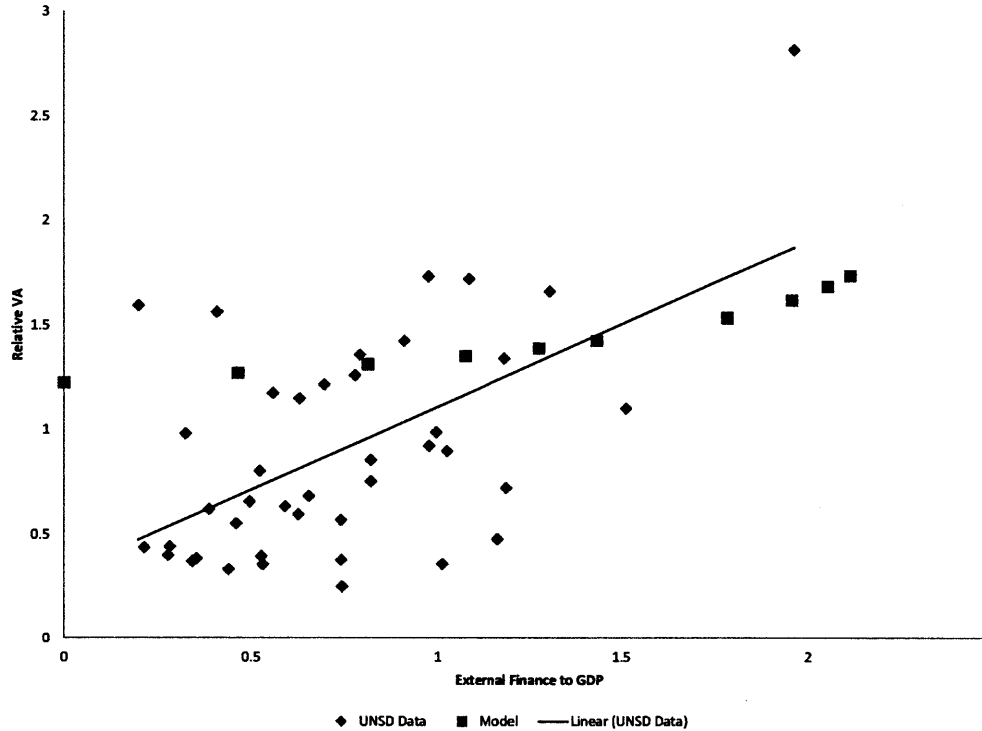
The rest of this section is organized in three subsections, each corresponding to one of the facts documented in Section 1.2. Subsection 1.5.1 compares the model's predictions with the data on financial development and cross-industry levels. Subsection 1.5.2 compares the model's predictions with the data on income inequality and cross-industry levels. Finally, subsection 1.5.3 deals with the interaction effects between financial development and income inequality, both for the model and the data.

1.5.1 Financial Development and Relative Levels

Section 1.2 established that sectors that rely more heavily on external finance exhibit disproportionately higher value added shares in countries with higher total capitalization ratios. In this section, I assess whether the calibrated model can match this fact. To do so, I set average wealth and the technology parameters at their US calibrated values, as specified in Table 9. I set the shape param-

eter of the wealth distribution at the value of the median country in the UNSD sample. I then vary the value of λ to span a range of external finance to GDP ratios as observed in the data.

Figure 5 compares the model's predictions on relative value added across sectors, $p_2Y_2/(p_1Y_1)$, to the 1980 UNSD data. As in the data, the model generates an upward sloping relationship between the external finance to GDP ratio and relative value added across sectors. The model, however, generates a flatter relationship. The regression coefficient of relative value added across sectors on the external finance to GDP ratio is 0.723 for the data and 0.238 for the model.³⁹ This suggests that the model explains as causal about 30% of the cross-country relationship between relative value added and finance.



Notes: The Figure plots the ratio of value added in sector 2 to value added in sector 1, $\frac{p_2Y_2}{p_1Y_1}$, against the ratio of external finance to GDP, for both the model's simulations and the UNSD data for 1980.

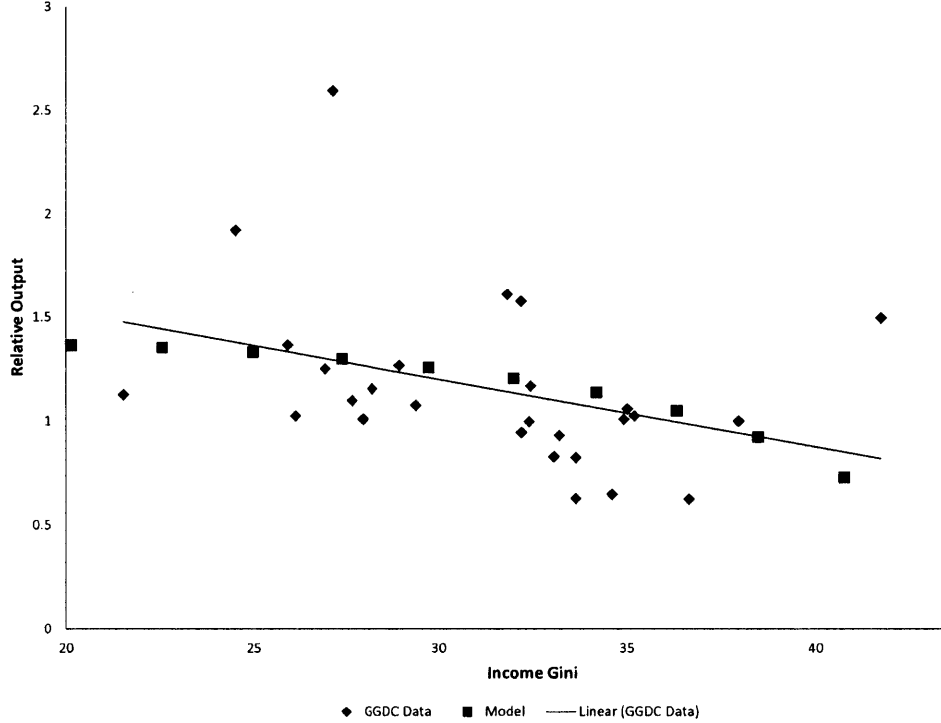
Figure 5: Financial Development and Relative Value Added

1.5.2 Inequality and Relative Levels

Sections 1.2 and 1.8.3 establish that sectors that rely more heavily on external finance exhibit disproportionately lower value added shares and output levels in countries with higher income inequality. I now assess whether the calibrated model can match these facts. To do so, I set average wealth and

³⁹Both coefficients are significant at the 1% level.

the technology parameters at their US calibrated values - see Table 9. I set the quality of financial institutions at the level of the median country in the UNSD sample. I then perform mean preserving spreads (henceforth MPS) to the distribution of wealth to span a range of income Ginis as observed in the UNSD sample.⁴⁰ In the sample, income Gini coefficients vary from approximately 25 to 62, with a median value of 38. The calibrated model is able to generate an income Gini coefficient of up to 40.⁴¹ Nevertheless, the range of income Ginis generated by the model is large enough to make a quantitative comparison with the data.



Notes: The figure plots the ratio of output in the high externally dependent sector to output in the low externally dependent sector, Y_2/Y_1 , against the income Gini coefficient.

Figure 6: Inequality and Relative Output: Model vs Data

Figure 6 shows relative output in sector 2, Y_2/Y_1 , against the income Gini coefficient both for the model and the GGDC data.⁴² Note that the model was calibrated to match several moments of the

⁴⁰A MPS consists of a reduction in θ and ω_{min} in such a way that average wealth, $E[G(\omega)]$, is kept constant. More specifically, a MPS consists of $(d\theta, d\omega_{min})$ such that $d\theta < 0$ and

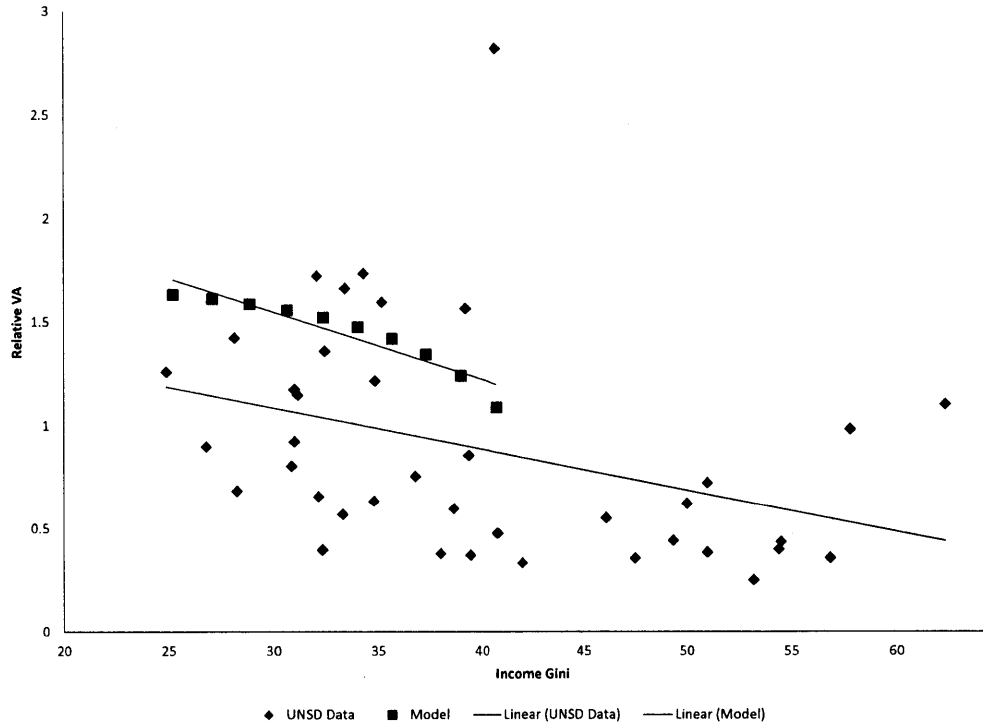
$$d\omega_{min} = \frac{\omega_{min}}{\theta(\theta - 1)} d\theta < 0$$

⁴¹Other models of occupational choice with collateral constraints also have a hard time in generating a high degree of income inequality. For example, JEONG AND TOWNSEND (2008) show that a calibrated version of the occupational choice model of LLOYD-ELLIS AND BERNHARDT (2000) is consistently unable to generate the degree of income inequality observed in the Thai data.

⁴²GGDC stands for Groningen Growth and Development Centre. See Section 1.8.3 in the Appendix for details on

US economy in the 1980s, while the GGDC data corresponds to OECD countries in 1997. For the simulated data, each point (square) corresponds to a different value of the shape parameter, θ . At the calibrated parameters, the model predicts that higher wealth inequality leads to both higher income inequality and *lower* relative output in the more externally dependent sector. This is consistent with the evidence from the GGDC data - see diamonds in Figure 6 below. The calibrated model fares very well with this feature of the data.

I now evaluate the model's predictions on relative value added. Figure 7 below shows the ratio of value added in the high external dependence sector to value added in the low external dependence sector against income inequality, both for the sample and the UNSD data. At the calibrated elasticity of substitution between sectors, the model's negative relation between inequality and relative output carries over to the relation between inequality and relative value added. Importantly, Figure 7 shows that this pattern is supported by the data.



Notes: The Figure plots the ratio of value added in the high external dependence sector to value added in the low external dependence sector, $\frac{p_2 Y_2}{p_1 Y_1}$, against the income Gini coefficient, for both the model's simulations and the UNSD data for 1980.

Figure 7: Inequality and Relative Value Added

To quantitatively evaluate the model, I compare regression coefficients from the real and the simulated data. Table 11 contains the results. Comparing coefficients in columns (1) and (3), we establish that the model accounts for about 65% of the relation between inequality and relative value the GGDC data.

added found in the data. Comparing columns (2) and (4), we see that the model accounts for about 37% of the relation between inequality and relative output found in the data.

	Data		Model	
	(1)	(2)	(3)	(4)
	Rel VA	Rel Output	Rel VA	Rel Output
Income Gini	-1.702*** (0.821)	-3.11* (1.65)	-1.135*** (0.083)	-1.458*** (0.110)
Observations	37	26	10	10
Adjusted R2	0.490	0.182	0.998	0.998

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. Rel VA stands for relative value added across sectors, $p_2 Y_2 / (p_1 Y_1)$. Rel Output stands for relative output across sectors, Y_2 / Y_1 . Column (1) uses data for 1980 from UNSD (value added) and IFS and IFC (capitalization ratio). Column (2) uses GGDC data for 30 OECD countries in 1997. Data regressions control for capitalization ratio, the stock of human capital and origin of the legal system (English, French, German or Scandinavian). Column (1) also controls for real per capita GDP. Simulated data regressions control for the external finance ratio.

Table 11: Inequality and Levels: Model vs Data

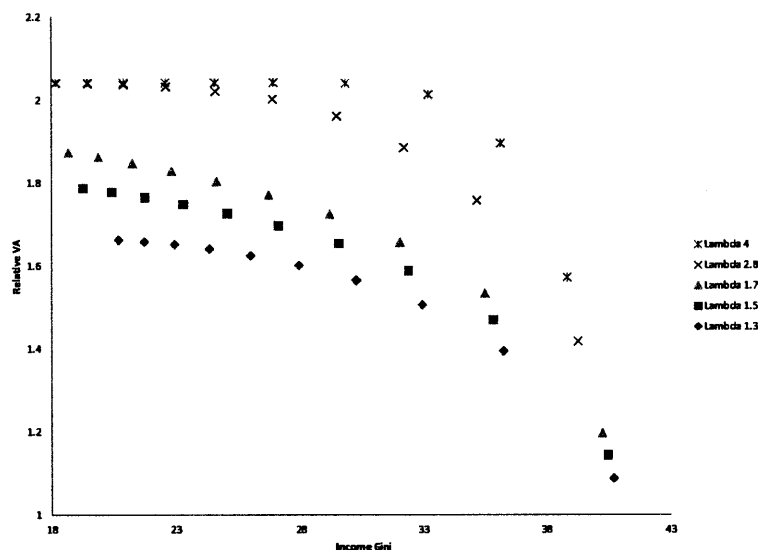
1.5.3 Interaction Effects

Sections 1.2.4 and 1.8.3 document the presence of interaction effects between financial development and income inequality. Specifically, Table 4 showed that income inequality reduces industry value added shares disproportionately more in sectors with high external dependence. Additionally, and perhaps counter-intuitively, Table 4 showed that this effect is *stronger* for more financially developed countries.⁴³ Table 19 in Section 1.8.3 in the Appendix shows a similar pattern for relative output: inequality has a disproportionately negative effect on relative output of the high dependence sector, and this effect *increases* with financial development. Table 5 showed that eventually, for a sufficiently high level of financial development, this effect is reversed and financial development weakens the effect of income inequality. In this section, I assess whether the calibrated model can generate this pattern.

Figure 8 below shows the effect of higher wealth inequality on relative value added in sector 2, $p_2 Y_2 / (p_1 Y_1)$, for different levels of financial development. We see that the negative effect of wealth inequality on relative value added becomes *stronger* when λ increases from 1.3 to 1.7. Eventually, for high enough λ , the negative effect of inequality on relative value added becomes weaker as λ increases. Thus, the model matches the type of non-monotone interaction effect found in the data. Figure 22 in the Appendix shows a similar pattern for the effect of inequality on relative output of sector 2. The intuition for this effect relies on the capital demand channel. Figure 9 below shows a partial equilibrium example of a redistribution that leads to the type of interaction effects found in the data. The Figure shows capital demand as a function of wealth for the case in which all sector 1 entrepreneurs are constrained, for two values of λ and given prices and thresholds. Consider a poor-to-rich redistribution of wealth between agents A and B. In the financially underdeveloped economy, both agents are borrowing at capacity and the redistribution has no effect on total capital demand.

⁴³To see this note that the coefficient for the triple interaction term between financial development, income inequality and external financial dependence is negative.

When financial institutions are improved, however, the wealthy agent reaches the optimal scale and the transfer of resources depresses total capital demand, worsening allocative efficiency. That is, the capital demand channel is stronger in the high- λ economy. At some point, for sufficiently high λ , both agents become unconstrained and the redistribution of wealth has no impact on capital demand. To summarize, the capital demand channel can account for the non-monotone interaction effect found in the data.



Notes: The Figure shows the effect of income inequality (generated via higher wealth inequality) on relative value added of sector 2, for different levels of financial development.

Figure 8: Interaction Effects, Relative Value Added

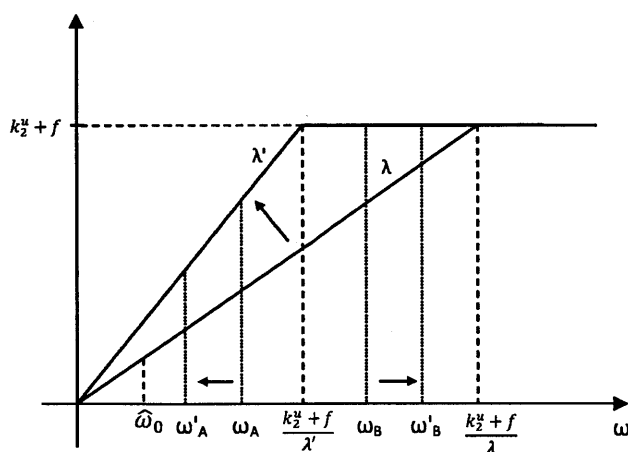


Figure 9: Interaction Effects and Capital Demand

1.6 Wealth Inequality and the Losses from Financial Frictions

Having established the goodness of fit of the calibrated model, this section studies the overall impact of wealth inequality on the economy. I find that, at the calibrated parameters, wealth inequality exacerbates the effects of financial frictions, placing the economy further away from its first best. I show that wealth inequality reduces production efficiency through the decreasing returns, the capital demand and the extensive margin channels. Quantitatively, the losses from wealth inequality can be large. An increase in wealth inequality that is consistent with an increase in income inequality of 15 points in Gini reduces per capita output by 46%. I show that about a quarter of these losses can be attributed to the extensive margin channel. Finally, by way of comparison, I compute the losses from financial frictions, keeping the distribution of wealth fixed. I find that financial frictions can reduce output per capita by up to 35%.

Section 1.6.1 studies the effects of increased wealth inequality and contains the main result of the paper. Section 1.6.2 quantifies the importance of the extensive margin channel. Section 1.6.3 assesses the sensitivity of the losses to changes in parameters. Finally, Section 1.6.4 computes the losses from financial frictions.

1.6.1 Increased Wealth Inequality

In this section, I study the effects of increased wealth inequality. To do so, I set average wealth and the technology parameters at their US calibrated values - see Table 9. I set the quality of financial institutions at the level of the median country in the UNSD sample. I then perform mean preserving spreads to the distribution of wealth to span a range of income Ginis observed in the data.

Figures 10 and 11 show the effect of wealth inequality on several equilibrium outcomes. At the calibrated parameters, the MPS to the distribution of wealth reduces capital demand. In turn, this reduces labor demand, as the labor choice of constrained agents is tied to their capital demand. In this way, both the interest rate and the wage are depressed - see upper part of Figure 10. Recall from Section 1.4 that the interest rate and the wage were already depressed as a result of financial frictions. As the economy tilts its production pattern towards sector 1, the relative price of sector 2 tends to increase - see lower part of Figure 10. The MPS tends to shift agents away from sector 2 and into sector 1 and the working occupation - see first two rows of Figure 11.⁴⁴ At the same time, the aggregate amount of capital held by sector 2 entrepreneurs is higher after the MPS, while aggregate capital in sector 1 is lower - see last row of Figure 11. Thus, the MPS results in fewer and on average larger firms in sector 2, and more and on average smaller firms in sector 1. Financial frictions have a similar effect on the distribution of firm size - see Section 1.4. This means that wealth inequality exacerbates the negative effects of financial frictions on the distribution of firm size. Finally, the MPS to the distribution of wealth tends to decrease the mass of agents that is able to enter sector 2 - see top right graph in Figure 11. This means that wealth inequality reduces production efficiency

⁴⁴The MPS places a higher proportion of agents below ω_0 , so that in partial equilibrium labor supply increases. This reinforces the fall in the wage rate, which in turn makes some agents enter entrepreneurship. In the new equilibrium the proportion of workers is higher.

also through the extensive margin channel.

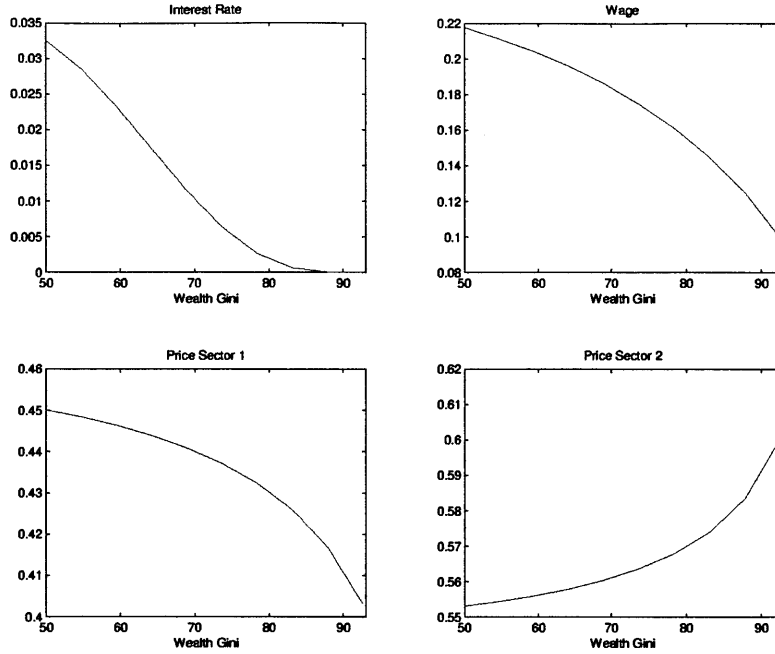


Figure 10: Wealth Inequality and Equilibrium Prices

I now quantify the overall impact of wealth inequality on real per capita output. Figure 12 shows output per capita relative to the US calibrated benchmark, for different values of exogenous wealth inequality. We see that wealth inequality reduces per capita output. Quantitatively, an increase in wealth inequality of 42 points in Gini reduces output per capita by 46.3%.⁴⁵ This number should be interpreted as an upper bound on the losses from wealth inequality. In terms of observables, such an increase in wealth inequality leads to an increase of 15.5 points in the income Gini, which is equivalent to 1.5 times a standard deviation of income inequality in the sample. Figure 13 compares the calibrated model simulations with cross-country data on income inequality and real GDP for 1980. For the model, I consider GDP relative to the US calibrated benchmark, while for the data I take GDP relative to the US. The regression coefficient of output per capita on the income Gini coefficient is -1.037 for the model and -1.982 for the data.⁴⁶ Comparison of these coefficients suggests that variation in wealth inequality can account for 52.3% of the relation between income inequality and real per capita GDP observed in the data.

⁴⁵ An increase of 42 points in the wealth Gini is admittedly a massive redistribution of wealth. Since data on wealth inequality across countries is, for the most part, unavailable, it is hard to assess whether such variation in the wealth Gini is realistic. The Luxembourg Wealth Study Database does provide measurements on wealth Ginis for a handful of countries. In 2002, Sweden had a wealth Gini of 89 while Italy had one of 60. Thus, a cross-country difference of about 30 points in wealth Ginis has been documented.

⁴⁶ Both coefficients are significant at the 1% level.

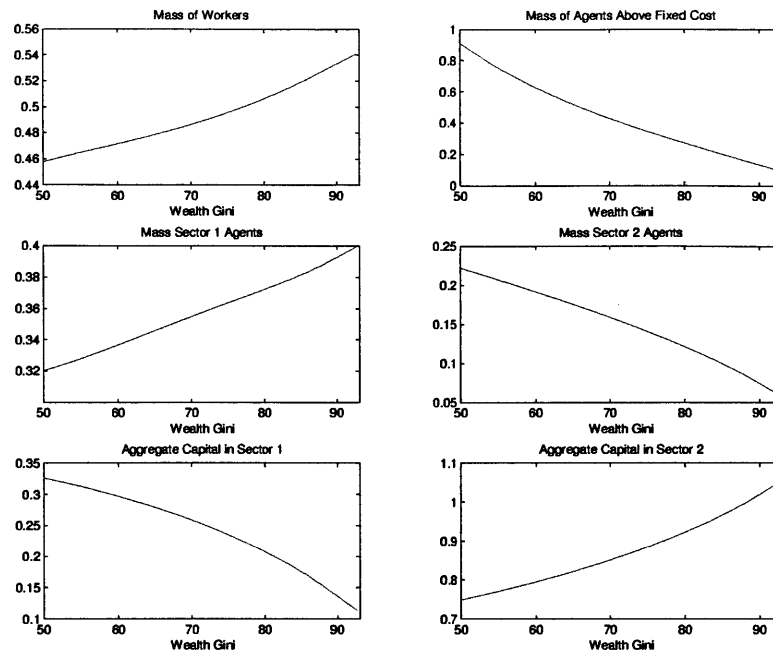


Figure 11: Wealth Inequality and Equilibrium Outcomes

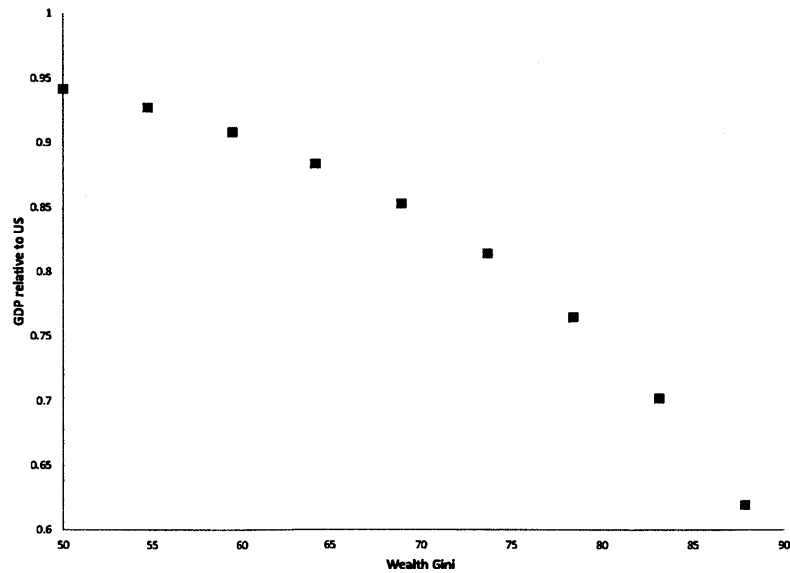
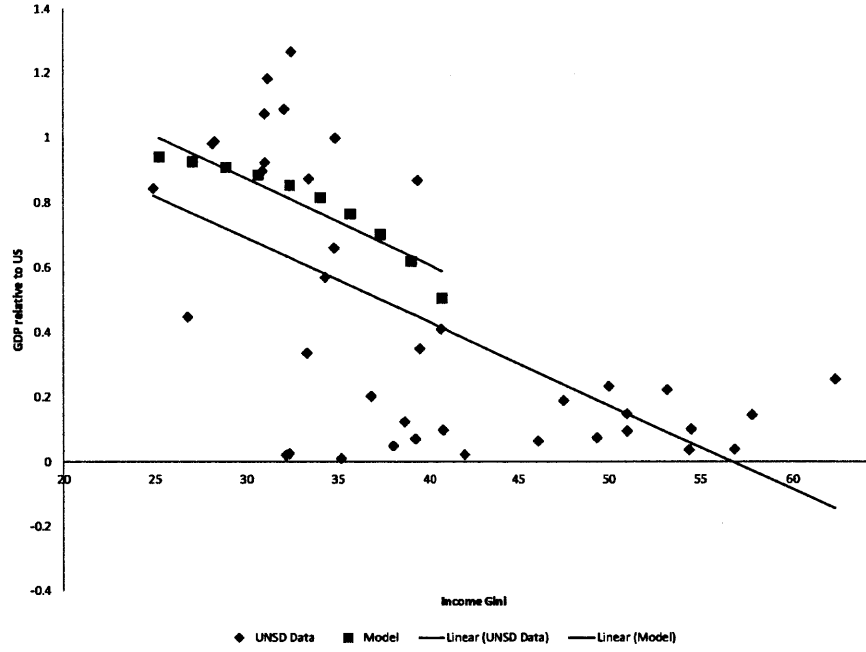


Figure 12: The Losses from Wealth Inequality



Notes: For the data, the Figure plots GDP relative to the US for 1980 against income inequality. For the model, the figure plots GDP relative to first best against income inequality.

Figure 13: Inequality: Model vs Data

To summarize, I find that higher inequality in the distribution of wealth tends to exacerbate the effects of financial frictions. This happens because inequality places resources in the hands of the wealthier, relatively unconstrained agents who have a lower marginal product of capital. Moreover, as wealthy agents tend to be operating at the optimal scale, and therefore have no use for extra funds other than lending, while wealth-poor agents tend to be borrowing at maximum capacity, inequality decreases capital demand. Furthermore, wealth inequality reduces the mass of agents that is able to meet the fixed cost and enter the more externally dependent sector. Thus, wealth inequality harms production efficiency through the decreasing returns, the capital demand and the extensive margin channels.

1.6.2 Losses from the Extensive Margin Channel

Figure 11 showed that wealth inequality leads to a decrease in the mass of agents above the effective fixed cost, f/λ . Recall that only agents with wealth higher than this threshold can enter sector 2 and that the equilibrium exhibits a suboptimally low mass of agents in this sector (see Section 1.4). This suggests that part of the losses found in the previous section come from the *extensive margin channel* - that is, the fact that wealth inequality reduces the mass of agents that is able to enter sector 2.⁴⁷

⁴⁷At the same time, we know from Section 1.3 that the extensive margin constraint never binds (i.e. $\hat{\omega} > f/\lambda$) - see also Figure 11.

To quantify the importance of this channel, I perform the following exercise. I consider the problem of a planner that can freely assign capital and labor to agents, and agents to sectors, subject to an exogenous constraint on the mass of agents that can be assigned to sector 2. Specifically, letting μ_0 and μ denote the mass of workers and sector 1 entrepreneurs respectively, the planner's problem is given by:

$$\max_{k_1, k_2, l_1, l_2, \mu, \mu_0} A \left[\gamma (\mu k_1^{\alpha} l_1^{(1-\alpha)\nu})^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) ((1-\mu-\mu_0) k_2^{\alpha} l_2^{(1-\alpha)\nu})^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} + (1-\delta) \mathbb{E}[\omega]$$

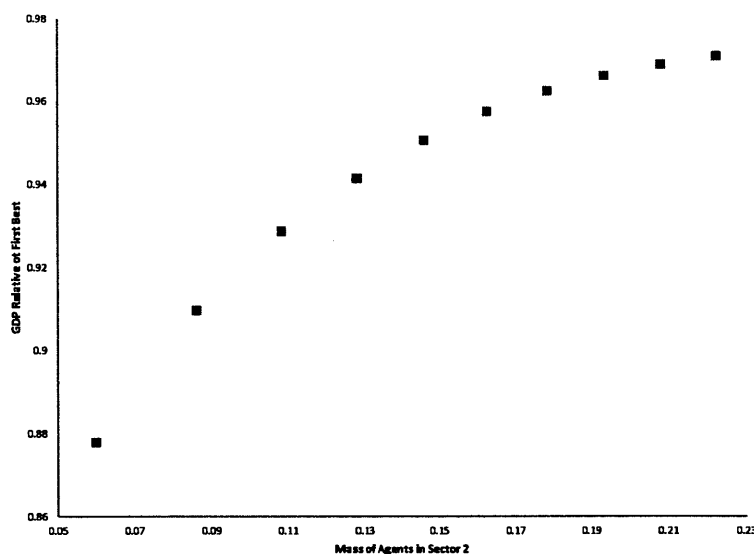
subject to

$$\mu k_1 + (1-\mu-\mu_0)(k_2 + f) = \mathbb{E}[\omega]$$

$$\mu l_1 + (1-\mu-\mu_0) l_2 = \mu_0$$

$$1 - \mu - \mu_0 \leq c$$

I keep the technology parameters and average wealth at their calibrated values. I study the losses in output per capita arising from variation in the maximum amount of agents that can be assigned to sector 2 (i.e. c). In particular, I decrease c from about 22% to 6%, which is the range for the mass of agents allocated to sector 2 that results from variation in wealth inequality, as obtained in the previous section - see Figure 11. Figure 14 contains the results. We see that a decrease in the maximum amount of agents that can be assigned to sector 2 from 22% to 6% leads to a reduction in output per capita of about 10%. This amounts to a quarter of the losses from wealth inequality found in the previous section.



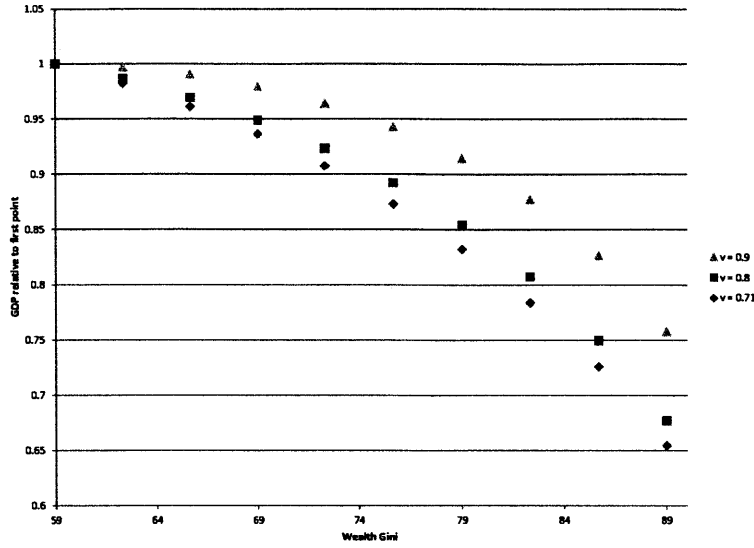
Notes: The Figure plots GDP relative to first best GDP against the maximum mass of agents that the planner can assign to sector 2.

Figure 14: Extensive Margin Losses

1.6.3 Sensitivity Analysis

How do the results of this section depend on the specific values of the parameters used? Here I focus on a crucial parameter: the span of control. Section 1.8.6 in the Appendix performs sensitivity analysis with respect to the fixed cost. The span of control parameter governs the degree of decreasing returns to scale present in the technology of intermediate goods. Figure 15 shows the effects of wealth inequality on income per capita for different values of this parameter. As expected, higher values of ν lead to smaller losses from wealth inequality, as the decreasing returns channel is weakened. However, the losses from wealth inequality are still large, even for $\nu = 0.9$: an increase in the wealth Gini from 59 to 89 points leads to a reduction in income per capital of about 25%.⁴⁸

⁴⁸Once I move away from the calibrated parameters, I do not use the model to map wealth to income inequality. Instead, I consider a realistic range of wealth Ginis. I take 59 and 89 since these values are observed in 2002 for Italy and Sweden, respectively, according to the Luxembourg Wealth Study data.



Notes: The Figure plots GDP relative to the first point against the wealth Gini coefficient, for different values of the span of control.

Figure 15: Span of Control and the Losses from Wealth Inequality

1.6.4 The Losses from Financial Frictions

I now use the calibrated model to study the effects of financial frictions on the economy. I set average wealth and the technology parameters at their US calibrated values, as specified in Table 9. I set the shape parameter of the wealth distribution at the value of the median country in the UNSD sample. I then vary the value of λ to span a range of external finance to GDP ratios as observed in the data.

Figures 16 and 17 show the effects of financial frictions on various equilibrium outcomes. As borrowing constraints are tightened, capital demand contracts and the interest rate decreases. The contraction in capital demand shifts labor demand downwards, resulting in a decrease of the wage. The decrease in λ decreases profits disproportionately more in sector 2, so that the wealth threshold $\hat{\omega}$ tends to increase, and more agents enter sector 1. The effect of financial frictions on the wealth threshold that separates workers from sector 1 entrepreneurs, $\hat{\omega}_0$, is non-monotone. Initially, profits in sector 1 increase - as the reduction in the interest and wage rates is very pronounced. This tends to push $\hat{\omega}_0$ downwards and decrease the mass of workers. As financial frictions become tighter, the decrease in the wage and interest rates becomes less pronounced.⁴⁹ This means that, at some point, profits of the marginal agent in sector 1 decrease, so that $\hat{\omega}_0$ and the mass of workers both increase. Irrespective of this non-monotonicity, the flow of agents from sector 2 to sector 1 is large enough so that the mass of sector 1 entrepreneurs monotonically increases as financial frictions become tighter.

⁴⁹Note the convex shape of the relationship between the interest rate and λ .

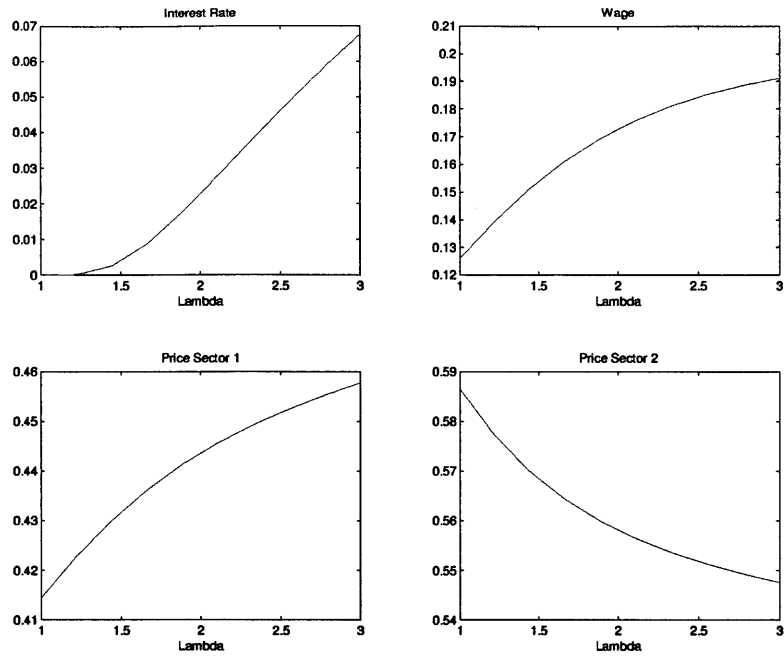


Figure 16: Effects of Financial Development, I

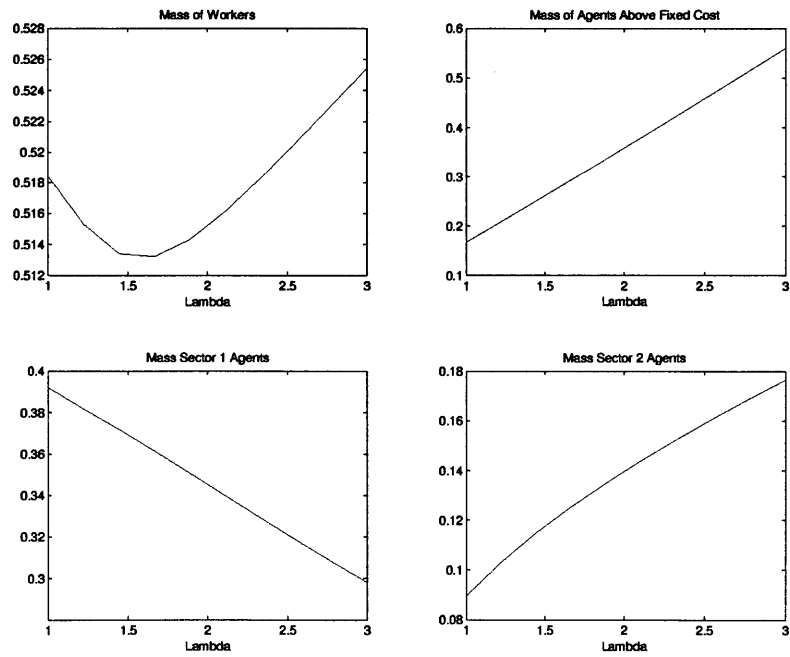


Figure 17: Effects of Financial Development, II

I now quantify the overall impact of financial frictions on output per worker. Figure 18 shows output per capita relative to the US calibrated benchmark, for different values of λ . We see that, in the calibrated model, financial frictions can reduce output to about 65% of the US level. In terms of observables, Figure 19 shows the cross-country relation between the ratio of external finance to GDP and output per capita relative to the US, both for the data and the model simulations. The regression coefficient of output per capita on the ratio of external finance to GDP is 0.163 for the model and 0.201 for the data.⁵⁰ Comparison of these coefficients suggests that variation in the quality of financial institutions can account for about 80% of the cross country relation between finance and GDP observed in the data.

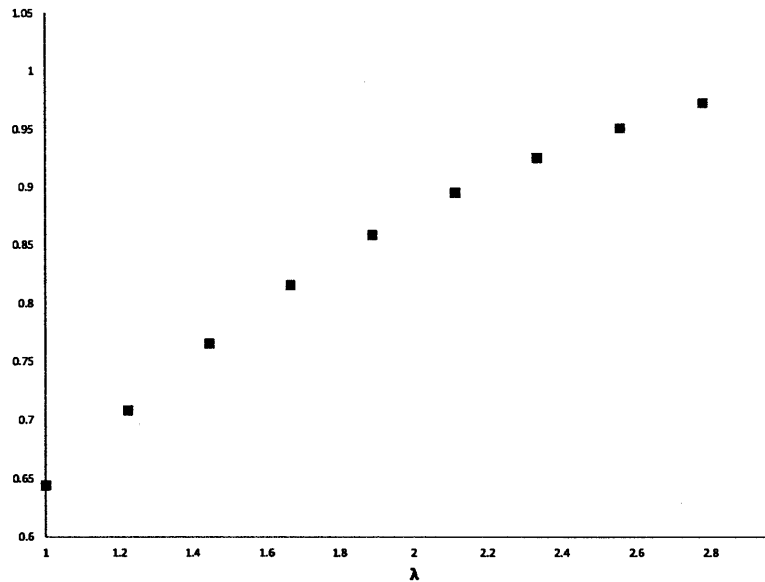
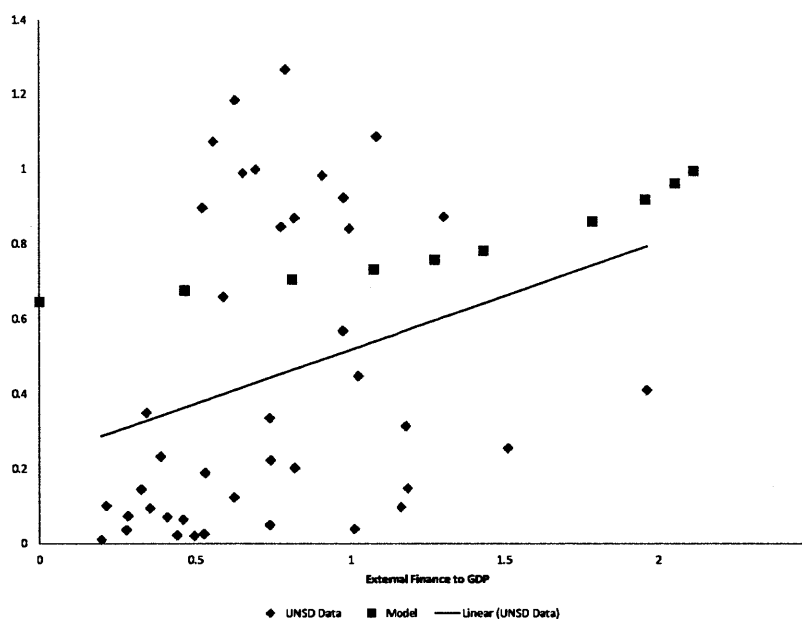


Figure 18: The Losses from Financial Frictions

⁵⁰Both coefficients are significant at the 1% level.



Notes: For the data, the Figure plots GDP relative to the US in 1980 against the external finance to GDP ratio. For the model, the figure plots GDP relative to first best against the external finance to GDP ratio.

Figure 19: Finance and Development: Model vs Data

In comparing the losses from financial frictions reported in this section with the ones found in the literature, an important caveat should be made. The literature typically studies the effect of financial frictions *across steady states* (see BUERA, KABOSKI, AND SHIN (2011), MIDRIGAN AND XU (2010)). That is, the economy is given an infinite amount of time to adjust to the change in financial institutions. In this section, I have studied the opposite case where the economy is given no time to adjust. In other words, I have computed the losses from financial frictions *on impact*.

1.7 Concluding Remarks

In this paper, I explore the effects of wealth inequality on macroeconomic aggregates, in an environment where financial markets are imperfect. More specifically, I ask whether wealth inequality tends to exacerbate or helps alleviate the degree of misallocation of production resources. To answer this question, I establish a number of new facts on the cross-sectoral effects of income inequality. I exploit the idea the inequality should have a differential effect on sectors that are more intensive in finance. By focusing on cross-sectoral outcomes, which allows me to include country-specific fixed effects, I am able to reach a higher standard of identification. I show that sectors that rely more heavily on external finance tend to be relatively smaller in countries with high income inequality.

To account for this fact, I build a two-sector model in which sectors differ in their fixed cost requirement, agents face collateral constraints, and production is subject to decreasing returns. Without restricting the parameter space, the effect of wealth inequality on the efficiency of production can go

in either direction. To discipline the analysis, I calibrate the parameters so that the model matches several moments of the US economy. To assess the model's performance, I show that the calibrated model is able to match the cross-sectoral facts documented in the empirical section. The main result of the paper is that, at the calibrated parameters, wealth inequality exacerbates the effects of financial frictions, placing the economy further away from its first best. This happens because wealth inequality drives resources towards agents with low marginal product of capital, reduces capital demand and reduces the number of agents that can enter the capital intensive sector. Quantitatively, variation in wealth inequality can reduce income per capita by up to 46%.

1.8 Appendix

1.8.1 Year of Inequality Data

Country	Gini Year	Country	Gini Year	Country	Gini Year
Australia	1979	Greece	1981	Pakistan	1979
Banglades	1978	India	1977	Peru	1981
Belgium	1979	Italy	1980	Philippines	1985
Brazil	1980	Japan	1980	Portugal	1980
Canada	1979	Jordan	1980	Singapore	1980
Chile	1980	Kenya	1992	South Africa	1993
Colombia	1978	Korea	1980	Spain	1980
Costa Rica	1981	Malaysia	1979	Sri Lanka	1980
Denmark	1981	Mexico	1977	Sweden	1980
Egypt	1975	Morocco	1984	Turkey	1973
Finland	1980	Netherlands	1979	UK	1980
France	1979	New Zealand	1980	Venezuela	1979
Germany	1978	Norway	1979	Zimbabwe	1990

Table 12: Year of initial inequality

1.8.2 Sectors by External Financial Dependence

The following table displays the 36 3-digit ISIC manufacturing sectors, in order of increasing external financial dependence, as measured in RAJAN AND ZINGALES (1998).

ISIC	Industrial Sector	External Dependence	ISIC	Industrial Sector	External Dependence
314	Tobacco	-0.45	332	Furniture	0.24
361	Pottery	-0.15	381	Metal products	0.24
323	Leather	-0.14	3511	Basic chemicals except fertilizers	0.25
3211	Spinning	-0.09	331	Wood products	0.28
324	Footwear	-0.08	384	Transport equipment	0.31
372	Non-ferrous metal	0.01	354	Petroleum and coal products	0.33
322	Apparel	0.03	3843	Motor vehicle	0.39
353	Petroleum refineries	0.04	321	Textile	0.40
369	Nonmetal products	0.06	382	Machinery	0.45
313	Beverages	0.08	3841	Ship	0.46
371	Iron and Steel	0.09	390	Other industries	0.47
311	Food products	0.14	362	Glass	0.53
3411	Pulp, paper	0.15	383	Electric machinery	0.77
3513	Synthetic resins	0.16	385	Professional goods	0.96
341	Paper and products	0.18	3832	Radio	1.04
342	Printing and publishing	0.20	3825	Office and computing	1.06
352	Other chemicals	0.22	356	Plastic products	1.14
355	Rubber products	0.23	3522	Drugs	1.49

Table 13: Manufacturing Sectors by External Financial Dependence

1.8.3 Robustness

In this section, I will show that the empirical results in Section 1.2 are robust to (i) the measure of income inequality used, and (ii) the measure of financial development used. I also show that the facts documented in Section 1.2 hold for industry output and export shares.

Alternative Measures of Income Inequality The main analysis focused on the Gini coefficient as a measure of income inequality. However, DEININGER AND SQUIRE (1996) provide us with other statistics of the income distribution. In this section, I focus on three other statistics of the income distribution: the quintile ratio, the share of income held by the richest 20% , and the share of income held by the poorest 20%. The quintile ratio is defined as the ratio of the first quintile (i.e. the share of the top 20%) to the last quintile (the share of the bottom 20%). I start by showing, at the cross-country level, that the effect of income inequality on relative value added is robust to using these other measures of income inequality. Table 14 contains the results. The results are consistent with the ones in Table 3. The quintile ratio and the share of the richest 20% are negatively associated with relative value added in the high dependence industries. The share of income held by the poorest 20% (a measure equality in the distribution of income) is positively associated with relative shares.

Dep. var.	Relative VA in High Dependence Industries		
	(1)	(2)	(3)
Capitalization ratio	0.715*** (0.223)	0.727*** (0.223)	0.697*** (0.219)
Quintile ratio	-0.021* (0.012)		
Share of richest 20%		-1.611* (0.934)	
Share of poorest 20%			7.726** (3.671)
Controls	Y	Y	Y
Observations	36	36	36
R2	0.4042	0.4012	0.4287

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the ratio of total value added in high external financial dependence industries to total value added in low external financial dependence industries in 1980. Controls include the stock of human capital, per capita income and an indicator variable for origin of the legal system (English, French, German or Scandinavian).

Table 14: Other Aspects of the Income Distribution, Cross-Country

I now re-do the cross-country cross-industry analysis for the three alternative measures of income inequality. The results are displayed in Table 15, which is the analog of Table 4 in the main text. We see that the quintile ratio and the share of the richest 20% have a disproportionately negative effect on industries that rely heavily on external finance. The share of the poorest 20% displays an opposite pattern. These results are consistent with income inequality inducing smaller value added shares in credit intensive sectors.

Dep. var.	Industry's Share in Manufacturing VA		
	X		
	Quintile Ratio	Richest Quintile	Poorest Quintile
$ed \cdot \lambda$	0.023*** (0.008)	0.054*** (0.018)	-0.006 (0.008)
$ed \cdot X$	0.038 (0.039)	0.040 (0.028)	-0.198 (0.147)
$ed \cdot \lambda \cdot X$	-0.069* (0.039)	-0.081** (0.032)	0.400** (0.189)
Observations	1124	1124	1124
R2	0.475	0.4763	0.4764

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the industry's share in total manufacturing value added in 1980. Data is taken from the UNSD. Richest (Poorest) Quintile stands for the share in income held by the richest (poorest) 20% of the population, as reported by DEININGER AND SQUIRE (1996).

Table 15: Other Aspects of the Income Distribution, Cross-Country Cross-Industry

Alternative Measures of Financial Development In the main analysis we measured financial development as the ratio of domestic credit plus stock market capitalization to GDP (i.e. the capitalization ratio). Here I will consider three alternative measures: (i) the ratio of domestic credit to the private sector plus stock market capitalization to GDP (which I will call the *private capitalization ratio*), (ii) the ratio of stock market capitalization to GDP, and (iii) the accounting standards. Note that the first measure is different from the measure used in the main text in that it excludes domestic credit to the public sector. The third measure, which is also used in RZ, captures the standards of financial disclosure in a country. The higher these standards are, the easier it will be for firms to raise external finance. I use an index created by the Center for International Financial Analysis and Research, which rates each country on a 0 to 90 scale. Data on accounting standards is for 1990. Table 16 displays the results. Columns (1) and (3) show that the effect of income inequality on cross-industry value added shares is qualitatively similar to the one found in the main text, when using the total capitalization ratio.

Output as Alternative Measure of Industry Levels While value added shares are naturally comparable across countries, the UNSD data cannot be used to compare sectoral output across countries, due to price level differences. For this reason, I use the Groningen Growth and Development Centre (GGDC) Productivity Level Database (INKLAAR AND TIMMER (2008)) which offers value added data for 30 OECD countries and 26 NACE industries. Crucially, the GGDC data provides industry-specific Purchasing Power Parities (PPPs), which capture differences in output price levels across countries at a detailed industry level. Since the PPPs are given for the benchmark year of 1997, value added data will be comparable across countries only for this year. An important difference with the UNSD dataset is given by the fact that the GGDC data is not restricted to the manufacturing sector.

Dep. var.	Industry's Share in Manufacturing VA 1980		
	Private Cap.	Stock Mkt. Cap.	Accounting Standards
Ext dep x λ	0.035** (0.015)	0.031 (0.020)	-0.0002 (0.0003)
Ext dep x gini	0.002 (0.020)	-0.034*** (0.012)	-0.096* (0.058)
Ext dep x λ x gini	-0.050* (0.029)	-0.031 (0.035)	0.001 (0.0009)
Observations	1196	1196	1009
R2	0.4719	0.4693	0.5264

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the industry's share in total manufacturing value added in 1980. Private Cap. stands for the private capitalization ratio, defined as the ratio of domestic credit to the private sector plus stock market capitalization to GDP. Stock Mkt. Cap. stands for the ratio of stock market capitalization to GDP. Accounting standards is an index developed by the Center for International Financial Analysis and Research ranking the amount of disclosure of companies' annual reports in each country.

Table 16: Other Measures of Financial Development

Descriptive Statistics I start by comparing real value added in industries with high and low reliance on external finance, for countries with high and low levels of income inequality. I classify the 26 NACE sectors into high and low external dependence. For each country and each sector, I compute real value added in million US dollars - using the country-sector specific PPPs. I then sum real value added for all sectors in the high and in the low external dependence groups. Finally, I split the countries into high and low income inequality (Panel A), and into high and low financial development (Panel B). Table 17 contains the results. We see that income inequality is associated with a *decrease* in the difference in real value added between high and low external dependence industries.⁵¹ The diff-in-diff estimate is negative. Panel B suggests that financial development is associated with higher real value added. Moreover, the positive effect of financial development is relatively uniform across sectors - the diff-in-diff estimator is positive, though not very large in magnitude.

⁵¹Put differently, income inequality is associated with an increase in real value added, and this increase is smaller for high external dependence sectors.

Value Added (millions USD)			
Panel A			
	High Inequality	Low Inequality	Difference
High FinDep	441,977	134,972	307,005
Low FinDep	443,922	102,611	341,311
Difference	-1,945	32,361	-34,306
Panel B			
	F. Developed	F. Developing	Difference
High FinDep	461,700	112,214	349,486
Low FinDep	444,752	101,652	343,100
Difference	16,948	10,562	6,386

Notes: The table shows average value added in high external dependence industries and low external dependence industries for 30 OECD countries, classified by income inequality and financial development. All data is taken from GGDC for 1997. The 26 NACE sectors are classified in a group of high external dependence and a group of low external dependence, according to the median level of external dependence. Then value added is summed across sectors within each group. High inequality countries are those with Gini coefficient larger than the median. Financially developed countries are those with capitalization ratio larger than the median.

Table 17: Descriptive Statistics for Industry Output

Cross-Country Analysis I now explore the effect of income inequality - and financial development - on relative *real* value added at the country level. For each country and sector, I compute real value added by deflating nominal value added with the country-sector specific PPPs. This is a measure of the sector's output that is comparable across countries. I then classify the 26 NACE sectors into two groups, according to their level of external financial dependence. I define relative real value added as the ratio of real value added in high to low external dependence sectors. Table 18 reports the results. Columns (1)-(3) indicate that income inequality is negatively associated with relative output in the high external dependence sectors. In contrast, financial development is positively associated with relative output. This is consistent with the results of the split-sample analysis of the previous section.

Dep. var.	Relative Real VA in High Dependence Industries		
	(1)	(2)	(3)
Capitalization ratio	0.204*		0.220**
	(0.112)		(0.102)
Gini		-3.24*	-3.11*
		(1.71)	(0.016)
Controls			
Observations	27	27	26
R2	0.083	0.090	0.182

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. Data is taken from GGDC for 1997. The sample includes 27 OECD countries and 26 NACE sectors per country. The dependent variable is the ratio of total real value added in high external financial dependence industries to total real value added in low external financial dependence industries in 1997. The capitalization ratio is defined as domestic credit + stock market capitalization over GDP.

Table 18: Cross-Country Regressions for Relative Output

Cross-Country Cross-Industry Analysis I now run the cross-country cross-industry specification in (2) with real value added instead of the industry's share as dependent variable. Table 19 contains the results. The coefficients in column (4) imply that both inequality and financial development reduce output disproportionately more in the high external dependence sectors. The negative sign of the coefficient for the triple interaction term implies that financial development strengthens the negative effect of income inequality on cross-industry output - an effect similar to the one found for value added shares.

Dep. var.	Real Value Added 1997			
	(1)	(2)	(3)	(4)
Ext dep x total cap	-25.79** (11.94)		-23.84** (10.05)	233.58* (137.54)
Ext dep x gini		-1.81 (1.25)	-1.38 (0.983)	3.92* (2.30)
Ext dep x total cap x gini				-7.91* (4.44)
Observations	780	754	754	754
R2	0.558	0.558	0.560	0.564

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is real value added for 26 NACE sectors and 27 OECD countries in 1997. The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by Rajan and Zingales (1998). The variable "total cap" stands for the total capitalization ratio, which is defined as the ratio of domestic credit plus stock market capitalization to GDP.

Table 19: Cross-Country Cross-Industry Regressions, Industry Output

Export Shares as Alternative Measure of Industry Levels In this section, I show that the main empirical result of the paper, namely that income inequality is associated with disproportionately lower levels in industries that rely more heavily in outside finance, also holds for export shares. I take data on the ratio of exports to GDP for a wide range of countries and industries from MANOVA (2008). Data for external dependence at the sector level is taken from BRAUN (2003). Data on financial development at the country level is taken from BECK, DEMIRGÜÇ-KUNT, AND LEVINE (2000). Finally, data from income inequality is taken from DEININGER AND SQUIRE (1996). Table 20 contains the results. Columns (2)-(4) show a negative and significant coefficient for the double interaction term that includes the income Gini coefficient. This suggests that more unequal countries feature disproportionately lower export shares in sectors that rely more heavily on external finance.

Dep. var.	Industry's Average Export Share 1980-1997			
	(1)	(2)	(3)	(4)
Ext dep x total cap	0.795*** (0.187)		0.646*** (0.1908)	0.848 (1.038)
Ext dep x gini		-6.191*** (1.207)	-4.619*** (1.143)	-4.239* (2.255)
Ext dep x total cap x gini				-0.482 (2.346)
Observations	1134	1161	1134	1134
R2	0.7153	0.7112	0.7186	0.7186

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the industry's export share averaged over the period 1980-1997, taken from MANOVA (2008). The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by BRAUN (2003). The variable "total cap" stands for the total capitalization ratio, which is defined as the ratio of domestic credit plus stock market capitalization to GDP. The coefficients estimates and standard errors of any term that includes the Gini coefficient were multiplied by 100.

Table 20: Cross-Country Cross-Industry Regressions for Exports

1.8.4 First Best Equilibrium

In this subsection, I outline the equilibrium conditions for the perfect credit benchmark (that is, the economy with $\lambda = \infty$). In this case, all agents achieve the optimal scale of production, and personal wealth is irrelevant for production decisions. Thus, every agent is indifferent between the different sectors and occupations. An equilibrium now consists of prices (p_1, p_2, r, w) , a mass of agents allocated to sector 1, μ , and a mass of workers, μ_0 , such that:

1. Indifference:

$$(1 - \nu) \left(p_1 A_1 \nu^\nu \left(\frac{\alpha}{r + \delta} \right)^{\alpha\nu} \left(\frac{1 - \alpha}{w} \right)^{(1 - \alpha)\nu} \right)^{\frac{1}{1 - \nu}} = (1 - \nu) \left(p_2 A_2 \nu^\nu \left(\frac{\alpha}{r + \delta} \right)^{\alpha\nu} \left(\frac{1 - \alpha}{w} \right)^{(1 - \alpha)\nu} \right)^{\frac{1}{1 - \nu}} - (r + \delta)f \quad (16)$$

$$= w$$

2. Capital market clearing:

$$\mu \left(p_1 A_1 \nu^\nu \left(\frac{1 - \alpha}{w} \right)^{\nu(1 - \alpha)} \left(\frac{\alpha}{r + \delta} \right)^{1 - \nu(1 - \alpha)} \right)^{\frac{1}{1 - \nu}} + (1 - \mu - \mu_0) \left(\left(p_2 A_2 \nu^\nu \left(\frac{1 - \alpha}{w} \right)^{\nu(1 - \alpha)} \left(\frac{\alpha}{r + \delta} \right)^{1 - \nu(1 - \alpha)} \right)^{\frac{1}{1 - \nu}} \right) \quad (17)$$

$$= \mathbb{E}[\omega]$$

3. Labor market clearing:

$$\mu \left(p_1 A_1 \nu^\nu \left(\frac{1 - \alpha}{w} \right)^{1 - \alpha\nu} \left(\frac{\alpha}{r + \delta} \right)^{\alpha\nu} \right)^{\frac{1}{1 - \nu}} + (1 - \mu - \mu_0) \left(p_2 A_2 \nu^\nu \left(\frac{1 - \alpha}{w} \right)^{1 - \alpha\nu} \left(\frac{\alpha}{r + \delta} \right)^{\alpha\nu} \right)^{\frac{1}{1 - \nu}} = \mu_0 \quad (18)$$

4. Final good optimality:

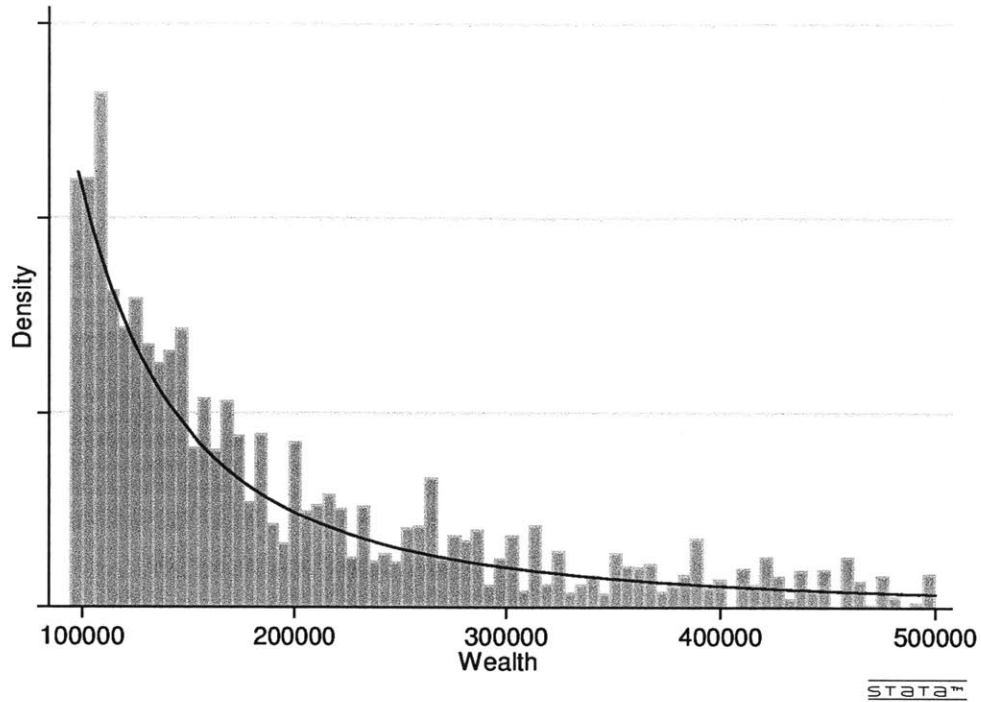
$$\mu (p_1 A_1)^{\frac{1}{1 - \nu}} = \left(\frac{\gamma}{1 - \gamma} \frac{p_2}{p_1} \right)^\varepsilon (1 - \mu - \mu_0) (p_2 A_2)^{\frac{1}{1 - \nu}} \quad (19)$$

5. Free entry into final good sector:

$$\left[\gamma^\varepsilon p_1^{1 - \varepsilon} + (1 - \gamma)^\varepsilon p_2^{1 - \varepsilon} \right]^{\frac{1}{1 - \varepsilon}} = 1 \quad (20)$$

1.8.5 US Distribution of Wealth and the Pareto Assumption

In this section, I show that the Pareto distribution is a good approximation of the upper tail of the wealth distribution. Figure 20 shows an histogram of the distribution of wealth among US households for 1983. Data is taken from the Survey of Consumer Finances. The figure shows households with wealth greater than \$95,000 - which represents 25% of the population. The figure also shows a Pareto density with shape parameter as the one assumed in the main text. We see that the Pareto density is close to the population histogram.



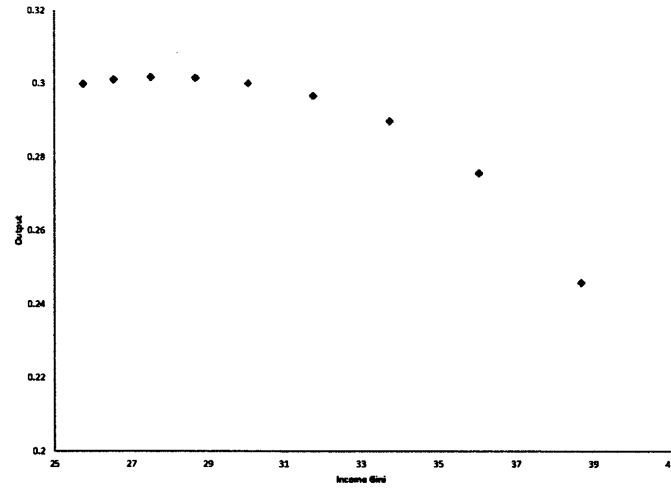
Notes: Data from the US Survey of Consumer Finances for 1983. The histogram shows data for households with wealth between \$95,000 and \$500,000. Both the normal and the high income sample are included. Wealth (net worth) is given by variable B3324, which is defined as gross assets excluding pensions plus total net present value of pensions minus total debt (B3305 + B3316 - B3320). The solid line corresponds to the density of a Pareto distribution, with scale parameter \$95,000 and shape parameter equal to 1.1412.

Figure 20: Upper Tail of Wealth Distribution

I also perform a maximum likelihood fit of the Pareto distribution for wealth levels above \$95,000, and find an estimated shape parameter of 1.13. The value found in the calibration done in the main text was 1.14.

1.8.6 Sensitivity Analysis

Figure 21 considers the case in which the fixed cost is higher ($f=200,000$ instead of 55,280). I find that for this case wealth inequality can have a positive effect on income per capita.

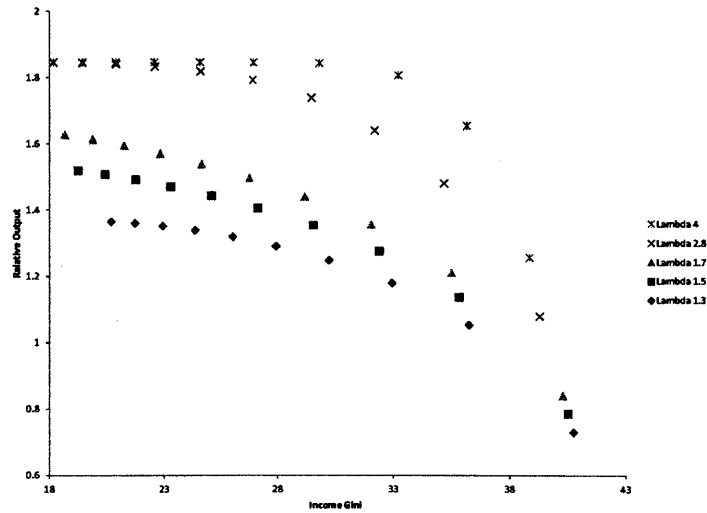


Notes: The Figure plots GDP relative to first best GDP against the maximum mass of agents that the planner can assign to sector 2.

Figure 21: Effects of Wealth Inequality for Higher Fixed Cost

1.8.7 Interaction Effects for Output

Figure 22 shows the effect of wealth inequality on relative output in sector 2, for different levels of financial development. The pattern is similar to the one reported in the main text for relative value added of sector 2.



Notes: The Figure shows the effect of income inequality (generated via higher wealth inequality) on relative output of sector 2, for different levels of financial development.

Figure 22: Interaction Effects in the Model

Chapter 2

Firm Heterogeneity and Import Behavior: Evidence from French Firms

2.1 Introduction

Trade in intermediate inputs is an important component of aggregate trade flows and has been growing at an enormous pace in the last decades (FEENSTRA, 1998; HUMMELS, ISHII, AND YI, 2001). Furthermore, a number of recent papers have established that trade in intermediate inputs can have substantial positive effects on firm productivity (AMITI AND KONINGS, 2007; GOLDBERG, KHANDELWAL, PAVCNIK, AND TOPALOVA, 2009; HALPERN, KOREN, AND SZEIDL, 2009). An analysis of firms' import demand is therefore central for our understanding of both aggregate trade flows and firm level productivity gains from international sourcing. So far, however, relatively little is known about firms' import behavior.¹ In particular, a theoretical framework of importing that is consistent with the firm-level evidence is missing. In this paper we take a step towards filling this gap. We start by proposing a simple model of import demand which is based on two core assumptions: productivity differences are the only source of firm-level heterogeneity and prices, fixed costs and input qualities are common across firms. We then use a comprehensive data set of French manufacturing firms to test its qualitative predictions on both the extensive and intensive margin. In this way, we identify the aspects of the data which such simple model can account for, and the ones for which further theoretical refinements are needed. Furthermore, we show the precise direction in which the core assumptions of the model need to be amended to qualitatively match the micro data.

In the last decade, the field of international trade has seen a fruitful interaction between theoretical work and micro evidence. However, the vast majority of these contributions has been concerned with the behavior of exporters. A first generation of empirical papers established a number of stylized facts, namely that few firms engage in exporting, that exporters are larger and more productive than non-exporters, and that exporters usually sell most of their output domestically (BERNARD AND JENSEN, 1999; BERNARD, JENSEN, REDDING, AND SCHOTT, 2007). These findings were accompanied, on the theory side, by the development of frameworks that allow for firm-level heterogeneity and assume fixed costs to exporting (MELITZ, 2003; BERNARD, EATON, JENSEN, AND KORTUM, 2003; CHANEY, 2008). More recently, EATON, KORTUM, AND KRAMARZ (2004, 2008) have uncovered a number of novel facts regarding the entry behavior of firms into different export markets, and have subsequently shown how these facts can be theoretically rationalized by augmenting MELITZ (2003) with various dimensions of firm-level heterogeneity as well as the marketing cost function of ARKOLAKIS (2008). Compared to the developments on the export side, our knowledge about

¹Notable exceptions are Bernard, Jensen, and Schott (2009); Bernard, Jensen, Redding, and Schott (2007), Halpern, Koren, and Szeidl (2009) and Kugler and Verhoogen (forthcoming, 2010).

firms' import decisions is rather limited. BERNARD, JENSEN, REDDING, AND SCHOTT (2007) show that the basic firm level facts about exporters are replicated for importers in the US, namely that importing is a rare activity and that importers are bigger and more productive than non-importers². More recently, HALPERN, KOREN, AND SZEIDL (2009) establish some new firm-level facts on entry into import markets, and estimate a structural model of import behavior to identify and quantify the mechanisms driving the productivity gains associated with imported inputs.³

To motivate the basic ingredients of the theory, we start by documenting a set of facts regarding the entry behavior of importers into different import markets. First, we find substantial heterogeneity in the number of imported products across firms: while the median importing firm sources only 6 products, many firms source more than 40. Second, we study a new entry margin by defining an import market as an 8-digit (NC8) product from a given country, that is, as a variety.⁴ We document the distribution of the average number of varieties per product French importers source, and find that the vast majority sources a limited number of varieties - 90% of the firms use less than three varieties per product. These facts are suggestive of firm-level differences in productivity, and non-trivial fixed costs to importing additional varieties. Finally, on the intensive margin, we document a striking degree of concentration in that importers spend most of their import expenditure on a small number of products and varieties: even intense importers, sourcing more than 50 products or 25 varieties per product, spend 80% of their expenditure on the top 5 products or varieties respectively. This suggests that quality differences across varieties are an important aspect of the data.

Based on these findings, we build a theoretical framework featuring firm-level productivity differences and variety-specific fixed costs and qualities. Firms are monopolistic producers of a differentiated good (as in MELITZ (2003)) and decide on the cost-minimizing way to produce. There is a set of potential inputs, each of which is available in a domestic variety and possibly many foreign varieties. The production technology features a love-of-variety effect, but the firm's ability to reap these benefits is limited by the presence of two types of fixed costs - to being an importer and to importing any specific variety. The model is standard in the following sense: (i) there is only one dimension of firm level heterogeneity (namely, productivity), and (ii) input prices, trade costs (both fixed and variable) and the qualities of imported intermediates are not allowed to be a function of firms' characteristics⁵, though they can differ across varieties.

On the extensive margin, the model predicts that more productive firms select into importing, import more products, and import more varieties of each product. The reason is that more productive firms benefit more from a given reduction in the marginal cost of production and are therefore willing to pay more for the possibility of using an extra input, or an extra variety of a given input (MELITZ, HELPMAN, AND YEAPLE, 2004). On the intensive margin, there are two main implications. The first

²In fact, this is reasonable given that importing and exporting are highly correlated.

³While Halpern, Koren, and Szeidl (2009) is closely related to this paper in that they also study firms' import demand, their emphasis is very different. Their main contribution is to quantify the importance of the quality and the complementarity channels by which imported inputs increase firm productivity. In contrast, we are interested in a model that can successfully account for the intensive and extensive margins of import demand.

⁴This definition of a variety is standard in the literature. See Broda, Greenfield, and Weinstein (2006).

⁵This contrasts with the assumptions made in the export literature (Eaton, Kortum, and Kramarz, 2008; Arkolakis, 2008).

implication of the model is intuitive: as more productive firms source more products (varieties), the model predicts that these firms spend a lower share of their expenditure on *each* product (variety)⁶. The second implication is more subtle. Our assumptions of common input prices and qualities across firms and factor neutral productivity imply that conditional on the sourcing strategy (i.e. which products and varieties to import), expenditure shares across products and varieties are fully determined by price-adjusted qualities. Firm-characteristics, in particular productivity, should not affect firms' relative input demand once the sourcing strategy is controlled for.

We then test these predictions using a dataset of French manufacturing firms. Overall, the model does fairly well when contrasted to the data. Concerning the extensive margin predictions, we find that more productive firms are more likely to be importers, import more products and more varieties per product. On the intensive margin, we first analyze the allocation of expenditure across imported inputs. We find that more productive firms have indeed lower expenditure shares for their individual varieties. More importantly, once we control for firms' sourcing strategies⁷, firm-productivity and other firm-characteristics cease to be important determinants. That is, we find that productivity affects foreign expenditure shares only through its effect on the sourcing strategy. We regard this as evidence supporting the two core ingredients of our standard model (namely factor neutral productivity and common prices and qualities across firms) when applied to the relative demand across foreign inputs. However, when we turn to firms' expenditure on domestic vs. foreign inputs, the model is not supported by the data. We show that after controlling for the sourcing strategy firm characteristics significantly affect domestic spending decisions. In particular, for a given sourcing strategy, more productive firms spend a higher share of their budget on domestic inputs. If French products are of high quality, this result is consistent with firm productivity and input quality being complements (see also KUGLER AND VERHOOGEN (2010)).

Taken together, these results indicate that a standard model of import demand with a single source of firm level heterogeneity and prices that cannot vary with firm characteristics is qualitatively consistent with the extensive margin evidence but is at odds with an important aspect of the intensive margin. While these assumptions seem to work reasonably well for spending decisions across foreign varieties, they are too restrictive to account for the pattern of expenditure on domestic inputs. In particular, a mechanism inducing firm level variation in the effective relative price of domestic inputs vis-a-vis foreign varieties (above and beyond the variation induced by the sourcing strategy) is required by the data. While an exact micro-foundation for such mechanism is beyond the scope of this paper, our results highlight the precise dimension in which the standard model needs to be augmented.

The rest of the paper is organized as follows. Section 2.2 documents some extensive and intensive margin facts about importers. Section 2.3 contains our theoretical framework to study the behavior of

⁶While this prediction seems to be almost mechanical, it is important to note that it would not hold in a variety of alternative settings. If, for instance, productivity was factor biased (see Kugler and Verhoogen (2010) for an example), an increase in productivity may increase the number of products sourced but some products would nonetheless receive a higher expenditure share. Thus, testing the prediction that more productive firms devote a lower share to *each* of their products is informative about the underlying production process.

⁷Recall that the sourcing strategy is defined as the set of products and varieties imported.

	Quantiles				
	25%	50%	75%	90%	99%
No of annual trade interactions per country	10	53	328	3,763	69,371
No of annual trade interactions per product	8	25	74	179	752
No of annual trade interactions per firm	2	8	25	59	238
Value of firm-product-country interactions (1000EUR)	44.15	268.53	1,258.83	5,319.10	70,993.13
Number of firm-product-country observations	705,316				

Table 1: The concentration of French imports.

importers. Section 2.4 brings the predictions of the model to the data and discusses the implications of the results. Finally, section 2.5 concludes.

2.2 Some Stylized Facts of Import Behavior

In this section we establish a number of novel facts about the import behavior of manufacturing firms. To this end, we use a comprehensive dataset containing all international transactions, as well as other important characteristics, of every manufacturing firm in the French economy for the years between 2001 and 2006. The main picture that emerges is one of high concentration among many different dimensions of the data. Few firms import but those who do spend most of their expenditure domestically. Regarding the import budget, even intense importers allocate most of it to a limited number of products and varieties.

2.2.1 Data

In this section we briefly describe our dataset. A more detailed description is contained in the Appendix. Because we are interested in the demand for inputs, we restrict the analysis to manufacturing firms. We observe import flows for every manufacturing firm in France from the official custom files. Manufacturing firms account for 31% of the population of French importing firms and 56% of total import value in 2001. Overall, French firms trade with a total 226 countries. The flows are classified at the 8-digit (NC8) level of aggregation, which means that the product space consists of roughly 9,500 products. Using unique firm identifiers we can match this dataset to fiscal files, which contain detailed information on firm characteristics. The final sample consists of an unbalanced panel of roughly 260,000 firms which are active between 2001 and 2006⁸.

A first overview over our dataset is contained in Table 1, which shows characteristics of the distribution of the number of annual variety flows (i.e. product-country cells) across firms.⁹ In total we observe roughly 700,000 variety-firm pairs. Given that there are about 30,000 importers in our data, the average importer imports about 23 varieties of potentially different products. Table 1

⁸This dataset is not new and has been used in the literature before (e.g. Mayer, Melitz, and Ottaviano (2010); Eaton, Kortum, and Kramarz (2004, 2008)). However, these contributions focused almost exclusively on the export side.

⁹Table 1 is of a similar flavor as the discussion of sparsity by Armenter and Koren (2008) but it is slightly different. Whereas they analyze the data on the *flow* level, we aggregate the data within a *firm-variety cell*, because it is these quantities which our model can speak to.

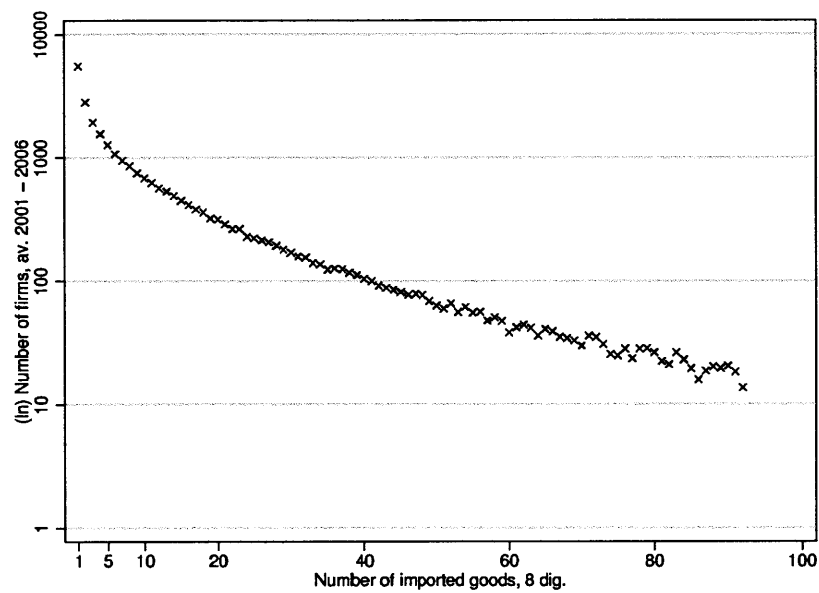
however shows that this average is not too informative as international activity is highly concentrated. The first two rows characterize the distribution of shipments across countries (row one) and products (row two) and show that French import flows are very concentrated - both geographically as well as in the product space. The median country is only active in 50 firm-product cells, whereas the top two exporting countries to France, namely Germany and Italy, report 70,000 interactions in distinct firm-product cells. A similar picture emerges when we look at the different products the French economy sources from abroad. For half of the potential products, i.e. roughly 5,000 products, only 25 country-firm interactions are observed, whereas the most popular products are shipped into France in more than 750 distinct country-firm combinations. Hence, international trade is very concentrated on few countries and few products. Note in particular the still very large difference between the 99% and 90%-quantile.

A similar concentration is also seen on the firm level. For most of the importing firms receiving an imported product is a rare event: the median firm sources only 8 varieties a year internationally. The top one percent of firms (that is, 300 firms) import 240 varieties. Finally, there is also a striking degree of heterogeneity in the total values different firms import from individual varieties. Whereas the most active firm-variety pairs are worth more than 70m EUR, a quarter of French importers import less than 45,000EUR worth of the varieties they source internationally within a year. Thus, at whatever dimension we look, the world of international trade is a small world. Few firms are actively participating and, when they do, they tend to import from a small set of countries and only a small subset of potential commodities.

2.2.2 Facts on Import Behavior

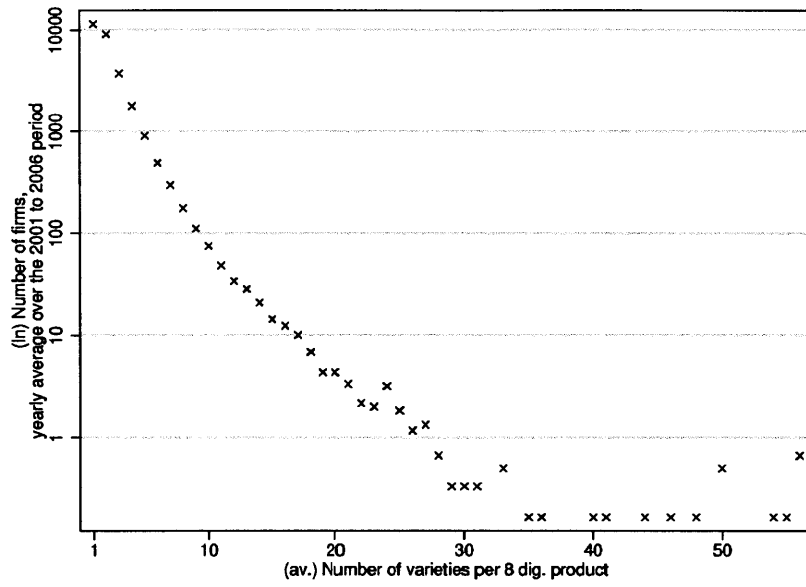
Fact 1. There is substantial heterogeneity in the number of products imported. The median importer sources 6 products from abroad, but some firms source up to 90 products. Figure 1 shows the number of firms importing k products for different values of k . Three properties stand out. First of all, there is substantial variation in the number of products sourced across importing firms. Whereas roughly 20% of firms source only one product, there are a number of firms importing more than 40 products from abroad. On average, French importers import 13 products from abroad, but due to the skewness of the distribution the median number of products is only 6. Secondly, the locus depicted in Figure 1 is strictly decreasing and for the more intense importers (i.e. firms importing more than 10 products), the graph is almost linear, so that the semi-elasticity of the “product extensive margin” is roughly constant. Increasing the number of imported products by one decreases the number of firms doing so by 1.4 percent. Finally, the schedule is highly convex, i.e. there are *much* fewer firms sourcing exactly 10 products than there are firms sourcing only one product.

Fact 2. Most firms source few varieties of each product. 90% of the firms source at most 3 varieties per product, and only 1% sources more than 8. In Figure 2 we depict the distribution of the average number of varieties per product. Figure 2 clearly shows that the vast



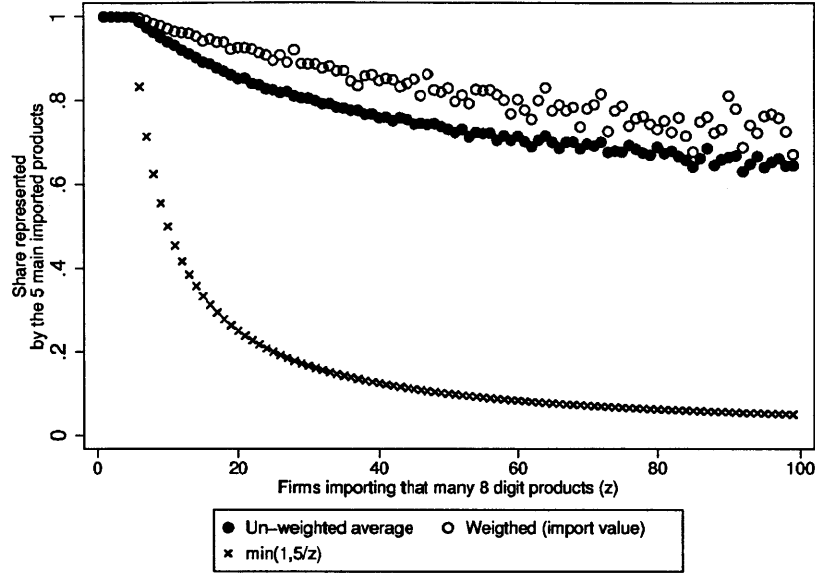
Notes: The figure shows the number of firms importing k products for different numbers of k . A product is defined on the 8-digit level and a firm is defined to be an importer of product k , whenever it imports a positive amount from at least one country. We use 6 years of data from 2001-2006 and report the yearly average.

Figure 1: How many products do firms import?



Notes: The figure shows the distribution of the average number of varieties per product, i.e. the distribution of $\bar{V}_i = \sum_k s_{k,i} V_{k,i}$, where $s_{k,i}$ is the expenditure share of firm i on product k and $V_{k,i}$ is the number of varieties firm i sources in product k . We use 6 years of data from 2001-2006 and report the yearly average.

Figure 2: How many varieties do firms source?

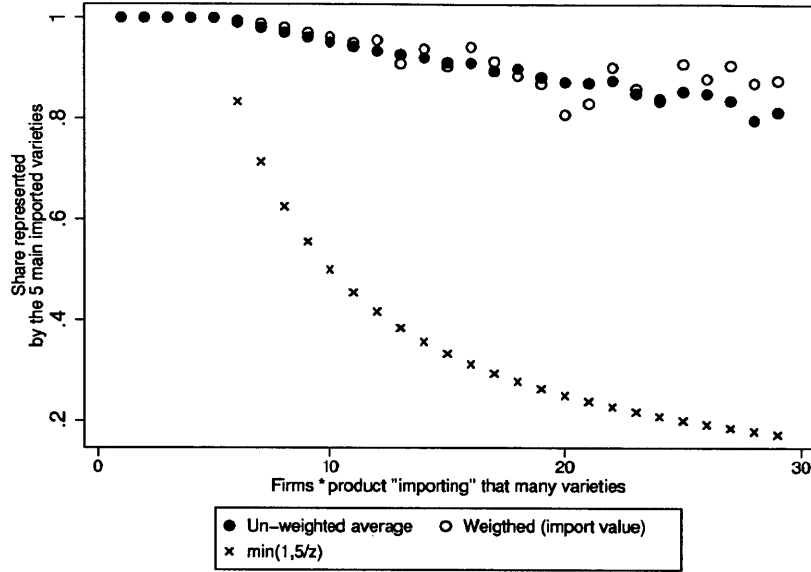


Notes: The figure shows the average expenditure share on the 5 most popular products of firms importing k products for different values of k . For the unweighted average all firms get an equal share, for the weighted results, we weigh firms by their import value. We also depict the counterfactual expenditure share if expenditures were equalized across products.

Figure 3: Concentration of firms' import spending across products.

majority of firms sources only a very limited number of varieties - 90% of French firms have less than three varieties per product and only one percent of the firms source more than 8 varieties per product. So if there are indeed high productivity gains through love of variety effects (HALPERN, KOREN, AND SZEIDL, 2009; GOLDBERG, KHANDLWAL, PAVCNIK, AND TOPALOVA, 2009), global efficiency gains from a finer division of labor are far from fully exploited.

Fact 3. Expenditure shares are highly concentrated across products. Firms importing 50 products spend 80% of their import budget on only 5 products. Importers spend an overwhelming part of their import expenditure on a small number of products. In Figure 3 we show the cumulative average expenditure share of the five most popular products for firms sourcing k products for different values of k . Given that firms who source only 6 or 7 products spend *by construction* at least a fraction of 72%-83% on their five most popular products, we also depict the counterfactual expenditure share if expenditures were equalized across products. It is clearly seen that the concentration is high. Firms sourcing 50 product still allocate 80% of their expenses on merely 5 products and even firms that source 100 products do so with 70% of their budget.



Notes: The figure shows the average expenditure share on the 5 most popular varieties of firm-product pairs with V many varieties for different values of V . For the unweighted average all firms get an equal share, for the weighted results, we weigh firms by their import value. We also depict the counterfactual expenditure share if expenditures were equalized across varieties.

Figure 4: Concentration of firms' import spending across varieties.

Fact 4. Expenditure shares are highly concentrated across varieties within products. Firms importing 25 varieties per product spend 80% of the product's expenditure on only 5 varieties. We now look at the allocation of expenditure within products. In Figure 4 we depict the average expenditure share on the top 5 varieties for firms sourcing V varieties per product for different values of V . Even firms sourcing 25 varieties, spend 80% of their total expenditure on those varieties on their 5 most popular ones.

2.3 A Simple Model of Importing

Motivated by these facts, we develop a theoretical framework to account for firms' import decisions. First, we allow for productivity differences across firms to be able to account for the startling degree of heterogeneity in firms' behavior. Second, we allow for variety-specific fixed costs of importing to rationalize the fact that most firms source a rather small number of products and varieties from abroad (Facts 1 and 2). Finally, we allow for differences in quality and transport costs across imported intermediates. This seems necessary in face of the high variation in expenditure shares documented in

Facts 3 and 4. We then impose two further assumptions that will play a key role in the results. First, we allow for a single dimension of firm-level heterogeneity (factor neutral productivity). Second, we restrict prices, product qualities and trade costs (both fixed and variable) to be common across firms. These two core assumptions constitute a natural starting point, and give empirical content to the model.¹⁰ We incorporate these elements in an otherwise standard model of international trade, which is probably the most basic model applied work would start with. This will allow us to identify the features of the data that such canonical model can and cannot explain, and thus to isolate avenues for future research.¹¹

We consider the following economy. On the output side, we adopt a specification similar to MELITZ (2003). There exists a continuum of firms, each of which is a monopolist in its particular product line. As stressed above, the single dimension of firm heterogeneity is their (factor neutral) productivity. Formally, each firm has access to a production function

$$y = \varphi q(z), \quad (1)$$

where φ denotes the firm's TFP, z is a vector of inputs and q is a constant returns to scale production function. To keep the model close to the empirical analysis, we make the usual distinction between products and varieties. In particular, we think of inputs as being different *products* when they come from different 8-digit product classes and differentiated *varieties* if they are in the same product class but sourced from different countries. Hence, $z = [z_{jk}]_{j,k}$, where k denotes a particular product and j denotes the variety of this product. For convenience¹² we model q as a nested CES production function

$$q(x_1, \dots, x_K) = \left(\sum_{k \in K} x_k^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \quad \text{where } x_k = \left(\sum_{j \in V_k} (\eta_{jk} z_{jk})^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}},$$

where η_{jk} measures the quality of variety j for product k and V_k denotes the set of varieties of product k .

On the demand side, consumers' preferences for the differentiated products are given by the usual CES aggregator

$$Y = \left(\int_0^1 y(\varphi)^{\frac{\sigma-1}{\sigma}} d\varphi \right)^{\frac{\sigma}{\sigma-1}},$$

where $y(\varphi)$ is the level of output of firm φ . Assuming that $\sigma > 1$, the demand for firm φ 's product

¹⁰These assumptions contrast with the ones made in Halpern, Koren, and Szeidl (2009), who assume fixed costs to vary at the firm level, and Kugler and Verhoogen (2010), whose model generates non-neutral productivity differences across firms.

¹¹The recent years have seen substantial progress on the export side, with Eaton, Kortum, and Kramarz (2008) allowing for firm-specific demand shocks, Arkolakis (2008) developing a microfoundation for heterogeneous fixed costs of entry and Bernard, Redding, and Schott (2010) considering multi-product firms. These are examples of theoretical advances being influenced by empirical failures of a standard model. As the theory of importing is less developed than its exporting counterpart, an empirical investigation of the qualitative patterns of a standard model will hopefully have similar consequences there.

¹²All of the theoretical results do not rely on the CES structure. Imposing the CES structure, however, gives us convenient closed form solutions for the demand systems, which will guide our empirical implementation in Section 2.4.

is given by

$$y(\varphi) = Yp(\varphi)^{-\sigma}, \quad (2)$$

so that the profit maximizing price is $p(\varphi) = \frac{\sigma}{\sigma-1} MC(\varphi)$, where $MC(\varphi)$ denotes the firm's marginal costs, and we use the ideal price index as the numeraire. Firms' marginal costs depend on their production decisions, in particular on their international sourcing strategy. We order varieties such that the first variety for each product refers to the domestic input. Firms take the set of prices $[p_{jk}]_{j,k}$ as given. These prices contain all variable transport costs which accrue whenever a foreign variety is acquired, that is, $p_{jk} = (1 + \tau_{jk})p_{jk}^*$, where p_{jk}^* is the price of product k at country j and τ_{jk} are the iceberg transport costs of product k from country j to France.

Sourcing a foreign input is subject to fixed costs. In particular, sourcing variety j of product k from abroad entails a fixed cost of $f_{jk} > 0$. Additionally, there is a fixed cost to being an importer, which we denote by $\kappa > 0$. We assume that there are no fixed costs to sourcing domestic varieties. The firm's cost-minimization problem consists therefore in choosing a sourcing strategy $V = (V_1, \dots, V_K)$ - which specifies a set of inputs K and sets of varieties V_k for each input- as well as input demands z_{jk} .

Consider a firm that has decided to follow a sourcing strategy given by V . Using the CES structure, standard calculations show that unit costs are given by

$$c(V_1, \dots, V_K) = c(V) = \left(\sum_{k \in K} \left(\sum_{j \in V_k} (\xi_{jk})^{\rho-1} \right)^{\frac{\sigma-1}{\rho-1}} \right)^{\frac{1}{1-\sigma}}, \quad (3)$$

where

$$\xi_{jk} \equiv \frac{\eta_{jk}}{p_{jk}} = \frac{\eta_{jk}}{(1 + \tau_{jk})p_{jk}^*} \quad (4)$$

is the quality flow per dollar spent of variety j in product k . Using (3), the marginal cost of production is therefore given by

$$MC(\varphi, V) = c(V) \frac{1}{\varphi}. \quad (5)$$

Note that $c(V)$, and hence $MC(\varphi, V)$, is strictly decreasing in the number of elements in V_k as the production function features a standard love of variety effect. This captures the efficiency gains from being active internationally.

Let us now turn to the choice of the optimal sourcing strategy. Using (5), the demand function (2) and the profit maximizing price, firms' profits are simply given by

$$\pi(V; \varphi) = \begin{cases} A \left(\frac{\varphi}{c(V)} \right)^{\sigma-1} & \text{if domestic} \\ A \left(\frac{\varphi}{c(V)} \right)^{\sigma-1} - \sum_{k \in K(\varphi)} \sum_{j \in V_k(\varphi)} f_{jk} - \kappa & \text{if importer} \end{cases} \quad (6)$$

where $A = \left(\frac{1}{\sigma-1} \right)^{1-\sigma} \left(\frac{1}{\sigma} \right)^{\sigma} Y$ is constant across firms. Given (6), the optimal sourcing strategy of

firm φ is then given by

$$V(\varphi) = (V_1(\varphi), V_2(\varphi), \dots, V_K(\varphi)) = \arg \max_V \pi(V; \varphi). \quad (7)$$

Given the complementarity between $c(V)$ and φ contained in (6), it is immediate that $c(V(\varphi))$ is weakly decreasing in φ so that more productive firms produce at lower marginal costs. In particular, there exists a critical level of productivity $\bar{\varphi} = \bar{\varphi}(f, \kappa, \xi)$ such that only firms with $\varphi > \bar{\varphi}$ are active internationally. Intuitively, more productive firms gain more from lowering their marginal costs and hence are more willing to pay the fixed costs to access a higher number of varieties (MELITZ, HELPMAN, AND YEAPLE, 2004).

This heterogeneity in sourcing strategies has also implications for the distribution of sales. In particular, sales are given by

$$\ln(p(\varphi)y(\varphi)) = \ln(\sigma A) + (\sigma - 1)(\ln(\varphi) - \ln(c(V(\varphi)))), \quad (8)$$

which now depend on firm productivity via the direct productivity effect ($\ln(\varphi)$) and indirectly through the sourcing strategy ($V(\varphi)$). As $c(V(\varphi))$ is decreasing in φ , sales are not only strictly increasing in productivity, but the elasticity of sales with respect to productivity exceeds $\sigma - 1$, the one of the closed economy.

Let us now turn to the set of implications which are more specific to firms' import behavior. First, we consider the number of varieties sourced internationally. While (7) shows that the marginal cost of production $c(V(\varphi))$ is decreasing in productivity via the endogenous sourcing decision, this does *not* imply that productive firms source *more* varieties. It might be that unproductive firms source multiple varieties with low fixed costs and low quality flows and high productivity firms concentrate on few fixed cost expensive varieties which yield high quality flows ξ . We can show, however, that under a mild condition¹³ the model predicts that less productive firms source a strict subset of the varieties their more productive counterparts import. This will be assumed from now on¹⁴. As a corollary, the model predicts that the number of importer products,

$$K(\varphi) = \sum_{k \in K} 1[V_k(\varphi) > 1],$$

is increasing in firm productivity.

The model also has strong implications for the intensive margin of trade. Using the CES structure, firm φ 's expenditure share on variety v for product k is given by

$$s_{vk}(\varphi) = \frac{p_{vk}z_{vk}}{\sum_{j \in V_k(\varphi)} p_{jk}z_{jk}} = \frac{(\eta_{vk}/p_{vk})^{\rho-1}}{\sum_{j \in V_k(\varphi)} (\eta_{vk}/p_{vk})^{\rho-1}} = \frac{\xi_{vk}^{\rho-1}}{\sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1}} = \frac{1}{V_k(\varphi)} \left(\frac{\xi_{vk}}{\xi_k(\varphi)} \right)^{\rho-1} \quad (9)$$

¹³We show in the appendix that to a first order approximation this will be satisfied whenever the relative efficiency gains of an additional variety for two firms do not exceed their relative sales.

¹⁴With a slight abuse of notation, $V_k(\varphi)$ will denote both the set of varieties and the total number of varieties that firm φ sources of input k .

where $\xi_k(\varphi) = \left(\frac{1}{V_k(\varphi)} \sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{1}{\rho-1}}$ is the average quality flow per variety of product k . (9) has two main implications which will be at the center of the empirical analysis. First, more productive firms are predicted to have lower expenditure share on *each* individual variety.¹⁵ Second, given a sourcing strategy $V(\varphi)$, expenditure shares are entirely determined from the distribution of price-adjusted qualities across varieties. It is important to note that our two core assumptions (namely, factor neutral productivity as the single source of firm level heterogeneity and prices, fixed costs and qualities being common across firms) imply that expenditure shares *only* depend on φ via the set of varieties sourced. This is an exclusion restriction which we will test in the data. Also note that this restriction does not rely on the CES functional form.

Since expression (9) also holds for the domestic variety, the model predicts that more productive firms spend relatively less on domestic inputs. However, for a given choice of imported varieties, domestic expenditure shares should not depend on productivity. The firm's total expenditure share on domestic products $s^D(\varphi)$ is a weighted average of product-specific domestic shares $s_k^D(\varphi)$, i.e.

$$s^D(\varphi) = \sum_{k \in K} s_k(\varphi) s_k^D(\varphi) = \sum_{k \in K} \frac{\left(\sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{\varepsilon-1}{\rho-1}}}{\sum_{k \in K} \left(\sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{\varepsilon-1}{\rho-1}}} s_k^D(\varphi). \quad (10)$$

Again, (10) shows that firms' domestic expenditure share depends on the price-adjusted qualities and on firms' sourcing strategies $V(\varphi)$ - conditional on the latter all firm characteristics are irrelevant.

To sum up, the main lessons we draw from this theoretical exercise are:

1. Importers are positively selected on productivity, i.e. the set of importers is given by $\mathcal{I} = \{\varphi | \varphi \geq \bar{\varphi}(f, \kappa, \xi)\}$, and sales are increasing in firm-productivity (see (8)).
2. The number of imported products is increasing in firm productivity φ .
3. Within products, the number of varieties firms import is increasing in firm productivity φ .
4. Expenditure shares across products and varieties are decreasing in firm-productivity. Furthermore, conditional on firms' sourcing strategies, expenditure shares across varieties and products are fully determined by the distribution of qualities $[\xi_{vk}]_{v,k}$ and thus do not depend on firm characteristics.
5. In particular, more productive firms have lower expenditure shares on domestic products.

In the following section we test these five predictions. Before doing so, we note that the model is consistent with the broad facts from the previous section. Dispersion in firm-level productivity translates into dispersion in the number of products sourced (Fact 1), and the number of varieties (Fact 2)¹⁶. Facts 3 and 4 can be rationalized by allowing the qualities and/or trade costs to have enough variation across products and varieties.

¹⁵Recall that this implication is not mechanical. See the discussion in footnote 6.

¹⁶Note that in the model's notation, Fact 2 depicts the histogram of $\bar{V}(\varphi) = \sum_{k \in K(\varphi)} s_k(\varphi) V_k(\varphi)$, where $s_k(\varphi)$ denotes the expenditure share firm φ spends on its imported product k .

Dep. var.	Indicator of import status				
	mean = 0.196				
	(1)	(2)	(3)	(4)	(5)
log Sales	0.107*** (0.000)	0.028*** (0.000)	0.029*** (0.001)		
Lagged Import Status		0.755*** (0.001)	0.018*** (0.004)	0.019*** (0.004)	0.018*** (0.004)
TFP-LP				0.009*** (0.001)	
TFP-OLS					0.010*** (0.001)
Exporter			0.088*** (0.002)	0.085*** (0.002)	0.085*** (0.002)
Corporate Group			0.013*** (0.002)	0.013*** (0.003)	0.012*** (0.003)
Foreign Group			0.013*** (0.005)	0.013*** (0.005)	0.013*** (0.005)
Firm FE	N	N	Y	Y	Y
R^2	0.396	0.750	0.875	0.878	0.879
Observations	1,107,962	858,456	858,394	637,780	639,016

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include year fixed effect, age fixed effect and sector fixed effects. The dependent variable is an indicator of the firm's import status. "Lagged Import Status" is an indicator for the firm's import status in the previous year. TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate.

Table 2: Selection into importing

2.4 Testing the Qualitative Predictions of the Model

The goal of this section is to test the five qualitative predictions derived above. An important issue that arises is that firm-level productivity is unobservable. We deal with this problem by taking the model at face value and proxying productivity with log sales, as (8) predicts a strictly monotone and roughly log-linear relation. As additional robustness checks we also consider two direct estimates of firm productivity. First we take an OLS-based measure by calculating TFP as the residual from industry-specific OLS regressions of log value-added on log capital and log employment (see BERNARD AND JENSEN (1999); KUGLER AND VERHOOGEN (FORTHCOMING)). Second we estimate firm-level TFP using the procedure proposed by LEVINSOHN AND PETRIN (2003).¹⁷

Prediction 1: Selection on productivity The fundamental sorting prediction of the model is that importers are positively selected on productivity. Table 2 reports the results of a regression of an import dummy on measures of firm productivity and various other firm characteristics. The

¹⁷We rely on the specification based on value added, using intermediate inputs as an instrument. As a third measure of TFP we also consider the firm-level Solow residual ($TFP = Y/(L^\alpha K^{1-\alpha})$ where α is a sector-specific wage share). Since the results are similar with this third measure, we only report the first two.

Dep. var.	ln nb. imported products				
	[ln] mean = [1.948] 17.657				
	(1)	(2)	(3)	(4)	(5)
log Sales	0.493*** (0.001)	0.436*** (0.002)	0.342*** (0.007)		
Exporter		0.292*** (0.007)	0.114*** (0.007)	0.140*** (0.007)	0.140*** (0.007)
Corporate Group		0.024*** (0.006)	0.045*** (0.007)	0.070*** (0.008)	0.071*** (0.008)
Foreign Group		0.365*** (0.008)	0.025** (0.010)	0.039*** (0.011)	0.035*** (0.011)
TFP-LP				0.068*** (0.005)	
TFP-OLS					0.106*** (0.006)
Firm FE	N	N	Y	Y	Y
R^2	0.449	0.463	0.918	0.914	0.915
Observations	167,733	167,711	167,711	156,506	158,460

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include age, 4-digit industry and year fixed effects. The dependent variable is the log of the number of imported products of firm i , i.e. $\ln(K_i)$, where $K_i = \sum_k 1[V_{k,i} > 1]$ and $V_{k,i}$ is firm i 's number of varieties of product k . TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate.

Table 3: Productivity and the number of imported products

prediction is borne out in the data. Column (1) shows that more productive firms, as measured by sales, are more likely to be importers. In columns (2) and (3) we control for additional firm characteristics which potentially affect import status and are correlated with productivity. That the lagged import status is highly significant suggests that fixed costs to importing are at least partly sunk. It is reassuring that exporters and members of a foreign or corporate group are more likely to be importers. Note that column (3) contains firm fixed effects. Finally, columns (4) and (5) show that these results are robust to using other measures of productivity. These findings are consistent with the literature (BERNARD, JENSEN, REDDING, AND SCHOTT, 2007; HALPERN, KOREN, AND SZEIDL, 2009; KUGLER AND VERHOOGEN, FORTHCOMING).

Prediction 2: More productive firms import more products Another extensive margin prediction of the model is that more productive firms source more products. Table 3 reports the results of testing this basic implication of the model. Column (1) shows that sales are strongly positively correlated with the number of imported products. Adding other firm level controls such as dummies for exporting status or membership in a foreign or corporate group reduces the coefficient only slightly and even after incorporating firm fixed effects in column (3) sales still have a very high

positive effect.¹⁸ As expected, exporters and members of corporate and foreign groups source more products internationally. Quantitatively, a 10% increase in sales is associated with a 3.5% increase in the number of products sourced. These results are robust to using other measures of productivity¹⁹ (see columns (4) and (5)).²⁰ Taken together, Figure 1 (from Section 2.2.2) and Table 3 are in line with the type of sorting implied by the model.

Prediction 3: More productive firms import a higher number of varieties The final extensive margin prediction of the model is that more productive firms import each product from more countries. We test this implication by regressing the average number of varieties firms source on measures of firm-level productivity and additional controls. The results are contained in Table 4. It is clearly seen that the coefficient on sales is positive and highly significant. In specification (2) we control for a host of firm-level characteristics which are likely to be important determinants of the demand for imported varieties. The coefficient on sales hardly changes. In column (3) we introduce firm fixed effects. The coefficient on sales decreases by a third but remains robustly positive. Furthermore it is seen that exporters and firms with foreign affiliates source more varieties per product. Somewhat surprisingly membership of a corporate groups is associated with sourcing less varieties although this effect vanishes once we include firm fixed effects.²¹ Quantitatively, 10% larger sales are associated with an increase of the average number of varieties sourced by about 1%. Finally these results are qualitatively confirmed with other measures of productivity (TFP-OLS and TPF-LP reported in columns (4) and (5)) and hold in specifications at the firm-product level, that is when taking the number of varieties per product ($V_{k,i}$) as the dependent variable.²² The results in Table 4 are therefore consistent with the sorting mechanism which lies at the heart of our model.

Prediction 4: Expenditure shares are decreasing in productivity. However, conditional on the sourcing strategy, productivity is irrelevant. Consider now the intensive margin, that is the expenditure shares across differentiated varieties within imported products²³. From (9) we have that

$$\ln(s_{vk}(\varphi)) = -\ln(V_k(\varphi)) + (\rho - 1)(\ln(\xi_{vk}) - \ln(\xi_k)), \quad (11)$$

¹⁸Note that the additional firm-level variables control for intra-firm trade, that is for trade between members of a corporate group in different countries.

¹⁹Note that TFP is itself a function of the number of products and varieties sourced, as TFP, when measured from firm revenues, is given by $TFP(\varphi) = \frac{\varphi}{c(V(\varphi))}$. However, $c(V(\varphi))$ is decreasing in φ if and only if more productive firms source more products, so that the results in Table 3 are still informative about the selection mechanism of the model.

²⁰We do not report these TFP measures in specifications without firm fixed effects, because in the cross-section, they are uncorrelated with sales and negatively correlated with importing status, which makes them unsuitable in the context of a Melitz (2003) model.

²¹One possibility why members of a corporate group source less foreign varieties might be that manufacturing units within a group rely on a French trading partner within the group to obtain their foreign inputs.

²²These results are not reported but available upon request.

²³This section deals only with foreign varieties. The domestic variety is excluded from this section, as it is the subject of the following one.

Dep. var.	ln av. nb. varieties				
	[ln] mean = [0,487] 1,998				
	(1)	(2)	(3)	(4)	(5)
log Sales	0.169*** (0.001)	0.151*** (0.001)	0.110*** (0.003)		
Exporter		0.090*** (0.003)	0.025*** (0.003)	0.033*** (0.004)	0.033*** (0.004)
Corporate Group		-0.016*** (0.003)	0.009** (0.004)	0.016*** (0.004)	0.017*** (0.004)
Foreign Group		0.149*** (0.004)	0.011 (0.007)	0.014* (0.007)	0.011*** (0.007)
TFP-LP				0.023*** (0.002)	
TFP-OLS					0.035*** (0.003)
Firm FE	N	N	Y	Y	Y
R^2	0.294	0.304	0.842	0.840	0.841
Observations	167,733	167,711	167,711	156,506	158,460

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include age, 4-digit industry and year fixed effects. The dependent variable is the log of the average number of varieties of firm i , i.e. $\ln(V_i)$, where $V_i = \sum_k s_{k,i} V_{k,i}$ and $V_{k,i}$ is firm i 's number of varieties of product k and $s_{k,i}$ is firm i 's expenditure share on product k . TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate.

Table 4: Productivity and the Number of Varieties

where $\xi_k = \left(V_k(\varphi)^{-1} \sum_j^{V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{1}{\rho-1}}$ is the average quality of the $V_k(\varphi)$ varieties of product k the firm sources. (11) shows that the expenditure share on individual varieties within products is decreasing in the number of varieties sourced of that product ($V_k(\varphi)$), and that it is decreasing in productivity (as $V_k(\varphi)$ is increasing in φ). Most importantly, conditional on $V_k(\varphi)$, firm characteristics, especially productivity, are excluded from the determination of expenditure shares. Intuitively, once the sourcing strategy is controlled for (which under Equation (16) reduces to the number of varieties), expenditure shares are only a function of price-adjusted qualities²⁴ which are assumed to be invariant across firms.²⁵ (11) suggest the following regression for each product-variety pair

$$\ln(s_{vk}^i) = \alpha_{vk} - \gamma_{vk} \ln(V_k^i) + \beta_{vk} \ln(S^i) + \mu_{vk} X^i + u^i, \quad (12)$$

where all parameters are variety-product specific, s_{vk}^i denotes firm i 's expenditure share on variety v of product k , S^i firm sales, V_k^i is the number of varieties firm i sources of product k and X^i contains additional firm characteristics. According to the theory, we expect that $\gamma_{vk} > 0$ and $\beta_{vk} = \mu_{vk} = 0$.²⁶ As our dataset contains 9,500 products and 220 countries, this approach would deliver $9,500 * 220 \approx 2,000,000$ predictions.²⁷ We rather choose a more parsimonious specification, where we focus on the expenditure share of the main variety only. Specifically, we take $s_k^{i,max} = \max_{v \in V_k^i} s_{vk}^i$, that is firm i 's expenditure share on its most important variety of product k , as the dependent variable and estimate

$$\ln(s_k^{i,max}) = \alpha_k - \gamma \ln(V_k^i) + \beta \ln(S^i) + \mu X^i + u_k^i,$$

now pooling the data across products.²⁸ Note that we allow for a product-specific intercept (α_k) but restrict the other coefficients to be the same across products. Table 5 reports the results.

The first two columns show that more productive firms, as measured by sales, and firms sourcing more varieties have lower average expenditure shares on their top variety within products. In column (3) we include both sales and the number of varieties sourced and find that while the coefficient on V_k^i hardly changes, the coefficient on sales drops to an economically insignificant level (in absolute value).²⁹ Hence, the effect of productivity on firms' expenditure shares within products is mainly

²⁴Note that these price-adjusted qualities contain prices, qualities and variable transport costs. See equation (4).

²⁵It should be noted that this result follows from two assumptions on technology: constant returns to scale and factor neutral productivity. The CES production function provides us with convenient closed form expressions.

²⁶Note that the error term u_i in (12) contains the term $\xi_k = \left(V_k(\varphi)^{-1} \sum_j^{V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{1}{\rho-1}}$ (see (11)), which is a function of $V_k(\varphi)$. Hence, we do not expect (12) to identify the structural parameter, i.e. we do not expect $\gamma_{vk} = 1$. However, since ξ_k is normalized by $V_k(\varphi)^{-1}$, if the qualities ξ_{vk} were constant within each product, then ξ_k would be constant too and would not depend on $V_k(\varphi)$. Thus OLS would be consistent in this case.

²⁷This number is an upper bound because in practice many product-variety pairs are empty.

²⁸Note that we could also run (12) on the pooled data (across products and varieties). This however does not deliver a very stringent test of the model. Since shares add up to one, the average expenditure on each variety mechanically equals $1/V$, if V varieties of product k are imported. Thus once the number of varieties is controlled for, it might not be surprising that other firm characteristics cease to be important. This is the case empirically. The results are not reported here, but available upon request

²⁹To see this, note that Table 5 implies that a 10% increase in sales increases the expenditure share on the most popular variety by 0.03%. As the share of the top variety is in the order of 0.9, such change would increase the share

Dep. var.	ln expenditure share on top foreign variety					
	[ln] mean = [-0,075] 0,942					
	(1)	(2)	(3)	(4)	(5)	(6)
log Sales	-0.013*** (0.000)		0.003*** (0.000)	0.002*** (0.000)		
log No. of Var.		-0.313*** (0.000)	-0.314*** (0.000)	-0.315*** (0.000)	-0.315*** (0.000)	-0.314*** (0.000)
Exporter				-0.001* (0.000)	0.000 (0.000)	0.000 (0.000)
Corporate Group				0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Foreign Group				0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
TFP-LP					0.000 (0.000)	
TFP-OLS						0.001** (0.000)
Product FE	Y	Y	Y	N	N	N
Firm FE	N	N	N	Y	Y	Y
R ²	0.068	0.609	0.610	0.616	0.615	0.615
Observations	2,864,122	2,882,210	2,864,122	2,863,926	2,715,758	2,796,491

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include year fixed effect and 3 digit industry fixed effects. Columns (1) - (3) contain product fixed effects (8 digit). We weigh observations such that each firm has an equal weight. The dependent variable is $\ln(s_k^{max})$, where $s_k^{max} = \max_{v \in V_k} s_k^v$ is the expenditure share on the most popular variety of product k . The number of varieties is the number of countries where product k is sourced from. TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate.

Table 5: Determinants of foreign expenditure shares

through its effect via the sourcing strategy as predicted by the theory. In column (4) we add both firm fixed effects and additional firm characteristics as exporting status and membership in a foreign and corporate group. We find that the previous results are confirmed, as the coefficient on the number of varieties sourced hardly changes while the additional firm-level controls are insignificant. Furthermore, the R^2 is basically unchanged, which shows that firm fixed effects, and hence any time-invariant firm characteristics, have little explanatory power.³⁰ Columns (5) and (6) show that these results are robust to using different measures of productivity.³¹

The main takeaway of the results in Table 5 is that the data does not seem to require firm-level heterogeneity, in particular productivity, to account for the determination of expenditure shares across imported products once the sourcing strategy is controlled for. This result is important, especially for applied theoretical work, because it provides support for the assumption of factor-neutral productivity differences across firms. Note that KUGLER AND VERHOOGEN (2010) find support for a complementarity between firm productivity and input quality, which is at odds with factor-neutral productivity. More precisely, they show that more productive firms source products of higher quality. The results reported in Table 5, however, do not concern this extensive margin. We study expenditure shares holding the sourcing strategy fixed. We come back to this discussion below.

Prediction 5. Domestic expenditure shares are decreasing in productivity. However, conditional on the sourcing strategy, productivity is irrelevant. The previous prediction should hold for every variety that a firm sources, in particular the domestic one. In this section we deal separately with the demand for domestic varieties for two reasons. First, as this paper is concerned with firms' import behavior, the domestic variety is of natural importance. Second, we do not observe domestic expenditure shares on the product level but only for the firm as a whole.³² Thus the regression of the previous section (see (12)) is not feasible. In our model, the domestic expenditure share at the firm level is given by (see (10))

$$s^D(\varphi) = \sum_{k=1}^K s_k(\varphi) s_k^D(\varphi) = \sum_{k=1}^K \frac{\left(\sum_j^{V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{\varepsilon-1}{\rho-1}}}{\sum_{k=1}^K \left(\sum_j^{V_k(\varphi)} \xi_{jk}^{\rho-1} \right)^{\frac{\varepsilon-1}{\rho-1}}} s_k^D(\varphi), \quad (13)$$

where $s_k^D(\varphi)$ is the domestic expenditure share in product k given in (9). Assuming that the domestic expenditure shares do not vary too much across products ($s_k^D(\varphi) \approx s^D(\varphi)$), (13) and (12) suggest to run the regression

$$\log(s_D^i) = \alpha - \gamma \ln(\bar{V}_i) + \beta \ln(S^i) + \mu X^i + u_i, \quad (14)$$

to 0.9003.

³⁰As a caveat, note that for computational reasons column (4) does not include product fixed effects.

³¹The results are also robust to using shares (as opposed to log shares) as dependent variable. We report the log specification (see (12)) because it follows from the theory.

³²Domestic input expenditure is measured as the difference between total expenditure on wares and inputs and the total value of imports.

where \bar{V}_i is the average number of varieties firm i imports.³³ Similarly to (11), (13) suggests that domestic expenditure shares should be negatively related to the average number of varieties sourced ($\gamma > 0$). Additionally, more productive firms should have lower domestic shares (since they source more varieties) but conditional on the number of varieties, productivity or any other firm characteristic should be irrelevant ($\beta = \mu = 0$). In other words, the effect of productivity on domestic expenditure shares happens only via the sourcing strategy.

It is important to note that aggregation bias is a potential concern when the regressions are done at the firm level. The reason is as follows. The main intensive margin prediction of the theory is that firm characteristics should not affect the allocation of expenditure *across* varieties *within* products. At the firm-product level, product fixed effects allow us to isolate this source of variation. This is not possible once the data is aggregated at the firm level. If the quality distribution of varieties differs across products - so that some products feature more concentrated expenditure shares -, and if firms differ in the products they use, a firm level regression may show a spurious correlation between expenditures shares and firm characteristics. To address this concern and for comparability reasons, we re-do the regressions of the previous section at the firm level.³⁴ Thus, we are able to assess the likely magnitude of such aggregation problem.

Table 6 contains the results for the domestic shares (panel A) and for the top foreign shares (panel B). Columns (1) and (2) in Panel A support the first part of prediction 5: both productivity and the average number of varieties have a negative effect on domestic expenditure shares. Column (3), however, shows that productivity matters for domestic expenditure shares above and beyond the sourcing strategy, as the coefficient for sales is positive and significant. Quantitatively, a one standard deviation increase in log sales (holding the sourcing strategy constant) implies an increase in the domestic expenditure share of 7% - which, given that the average domestic shares is about 70%, amounts to 5 additional percentage points. This is in stark contrast with the result for the shares on foreign varieties in Table 5, which shows an economically insignificant coefficient on sales. More importantly, the sales coefficient in the domestic shares regression (see column (3), panel A) is three and half times as high as the one in the foreign shares regression (see column (3), panel B). By comparing panels A and B we are confident that this result is not due to aggregation bias. Note also the large difference in the R^2 between panels. Thus, we find that the sourcing strategy, which according to the model should be a "sufficient statistic" for the pattern of expenditure, has low explanatory power when applied to domestic spending, but explains foreign input demand relatively well. Column (4) adds additional firm level controls and firm fixed effects. While the sales coefficient in panel A drops, it is still significant and is now four times larger than its counterpart in panel B.

³³To see this more formally, write the domestic expenditure share as

$$\ln(s_k^D(\varphi)) = \ln\left(\frac{\xi_{Dk}^{\rho-1}}{\sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1}}\right) = -\ln(\bar{V}(\varphi)) + (\rho-1) \left(\ln(\xi_{Dk}) - \ln\left(\bar{V}(\varphi)^{-1} \sum_{j \in V_k(\varphi)} \xi_{jk}^{\rho-1}\right) \right),$$

where $\bar{V}(\varphi) = \sum_k s_k(\varphi) V_k(\varphi)$. Under the assumption that $s_k^D(\varphi)$ does not vary across k , the last term in brackets is independent of k and (14) follows.

³⁴More precisely, we re-estimate (14) using the log average expenditure share on the most popular variety as the dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A-Domestic	ln expenditure share on domestic inputs					
	[ln] mean = [-0.500] 0.700					
log Sales	-0.019*** (0.001)		0.042*** (0.001)	0.028*** (0.006)		
log Avg. No of Var.		-0.295*** (0.003)	-0.359*** (0.004)	-0.162*** (0.005)	-0.156*** (0.005)	-0.156*** (0.005)
Exporter				-0.042*** (0.006)	-0.037*** (0.005)	-0.036*** (0.005)
Corporate Group				-0.019*** (0.006)	-0.018*** (0.006)	-0.019*** (0.006)
Foreign Group				-0.017 (0.011)	-0.016 (0.011)	-0.017 (0.011)
TFP-LP					0.008* (0.004)	
TFP-OLS						0.005 (0.006)
Firm FE	N	N	N	Y	Y	Y
R ²	0.041	0.093	0.101	0.763	0.770	0.770
Observations	152,367	154,173	152,367	152,348	143,449	145,143
Panel B-Foreign	ln average expenditure share on top foreign variety					
	[ln] mean = [-0.114] 0.904					
log Sales	-0.032*** (0.000)		0.012*** (0.000)	0.007*** (0.001)		
log Avg. No. of Var.		-0.240*** (0.001)	-0.257*** (0.001)	-0.248*** (0.002)	-0.246*** (0.002)	-0.245*** (0.002)
Exporter				-0.002** (0.001)	-0.001 (0.001)	-0.001 (0.001)
Corporate Group				0.003** (0.001)	0.003** (0.001)	0.003*** (0.001)
Foreign Group				0.001 (0.002)	0.000 (0.002)	0.000 (0.002)
TFP-LP					0.003*** (0.001)	
TFP-OLS						0.003*** (0.001)
Firm FE	N	N	N	Y	Y	Y
R ²	0.115	0.614	0.622	0.823	0.823	0.823
Observations	167,733	170,267	167,733	167,711	156,506	158,460

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include year fixed effects and 3 digit industry fixed effects. The dependent variable in Panel A is the log of the domestic expenditure share. The dependent variable in Panel B is the log of the firm-level average expenditure share on the most popular variety of each product sourced, i.e. $\sum_k s_k^{max} \omega_k$, where ω_k is the expenditure share of product k and $s_k^{max} = \max_{v \in V_k} s_k^v$. "Log Avg. No of Var." is the firm-level average number of varieties across products, $\bar{V} = \sum_k V_k \omega_k$. TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate.

Table 6: Domestic and foreign expenditure shares at the firm level

Moreover, firm level characteristics are economically significant, while this is not the case in panel B. Both being an exporter and being member of a corporate or foreign group reduce the expenditure share on domestic inputs. Finally, the large increase in R^2 from column (3) to (4) in panel A confirms the importance of firm characteristics as determinants of domestic expenditure shares. Columns (5) and (6) report the results using other measures of firm level productivity as robustness measures. While the coefficients on the TFP measures in panel A still exceed the ones in panel B, they are too imprecisely estimated to reach a firm conclusion. However, firm characteristics are still much more important in panel A than in panel B.

Taken together, these findings suggest that the theory is applicable to foreign expenditure shares, but that it is incomplete to account for the pattern of domestic spending. That is, simply relying on factor neutral productivity differences across firms seems insufficient to describe the firm-level evidence on relative domestic spending.³⁵

Discussion We consider the results contained in Tables 5 and 6 as the most relevant ones for future research. Whereas Table 5 was in line with foreign spending patterns being uncorrelated with firm characteristics, Table 6 indicates that this is not true concerning the domestic-vs-foreign spending allocation. This means that the relative effective price of foreign inputs varies across firms for a given sourcing strategy. The basic theory we consider, however, rules this out. With CES production structure, the relative price of foreign varieties when sourcing $V = (V_1, \dots, V_K)$ varieties is given by

$$P_F(V) = \left(\sum_k^K \left(\sum_{j \neq 1}^{V_k} \xi_{jk}^{\rho-1} \right)^{\frac{\epsilon-1}{\rho-1}} \right)^{\frac{1}{1-\epsilon}}. \quad (15)$$

Clearly, $P_F(V)$ depends on productivity as the sourcing strategy V does. But conditional on V , (15) shows that $P_F(V)$ does not vary with φ (or any other firm characteristic) under the assumption that firms face common prices and qualities. Although (15) follows from the CES functional form, it is important to note that this property does not require this assumption. As long as productivity differences across firms are factor-neutral, production has constant returns, and prices and qualities are common, all firms face the same relative price of foreign inputs for a given sourcing strategy. The results in the previous sections show that these assumptions are not appropriate.

While it is interesting that the model is rejected for the domestic-foreign comparison, it is important to learn the direction in which the model should be augmented to be consistent with the data. To do so, we need to interpret the signs of the coefficients of interest in panel A of Table 6. However, once we recognize that productivity has an independent effect on expenditure shares (above and beyond the sourcing strategy), and given that productivity matters for import participation (see Table 2), the results in panel A are likely to be subject to selection bias. For this reason, we

³⁵It is interesting to note that Halpern, Koren, and Szeidl (2009), who use a similar demand structure to ours, have also problems to account for the domestic expenditure shares using their structural estimation. At their estimated parameters, the optimal import share is roughly 60% (see their Table 3), which is more than double the share observed in the data (28%).

re-estimate equation (14) using the standard procedure proposed in HECKMAN (1979). For greater comparability, we also re-do the regressions in panel B controlling for selection. Table 7 has the results.

Consider first panel A. The results for productivity are qualitatively similar to those reported in Table 6. However, the size of the productivity coefficients is between two and four times as large. This tells us that controlling for selection into importing is important, and that firm productivity is a significant determinant of the demand for domestic inputs.³⁶ In particular, column (1) shows that more productive firms spend relatively more on domestic inputs, despite them sourcing more varieties (as shown in prediction 2). The coefficient increases fivefold once we control for the sourcing strategy in column (3) indicating that the coefficient in column (1) captures two effects. Productivity decreases the expenditure share on domestic inputs via its positive effect on the number of varieties, but has also a positive direct effect. This result is confirmed with the other two measures of firm level productivity which are positive, sizable and highly significant. Panel B of Table 7 confirms that productivity does not have a direct effect on expenditure shares of foreign varieties. After controlling for selection, the coefficients are virtually identical to the ones in panel B of Table 6, and the inverse Mill's ratio is small and ceases to be significant once firm fixed effects are included.

Taken together, these results show that, for a given sourcing strategy, productivity does not affect relative spending across imported products but increases the share of domestic inputs relative to foreign ones. The latter is in line with the hypothesis that firm productivity and input quality are complements (see KUGLER AND VERHOOGEN (2010)), if French inputs are of relatively higher quality than foreign ones (HUMMELS AND KLENOW, 2005). However note that this type of complementarity can only be part of the story. As foreign inputs differ in their quality³⁷, such complementarity would imply that more productive firms spend relatively more on varieties of high quality. This is inconsistent with the results in Table 5.

Let us now briefly discuss two directions how the basic framework could be amended to accommodate these findings. A first route would abandon the reliance on a single source of heterogeneity (productivity) and introduce a second characteristic, varying at the firm level. To be consistent with Tables 5 and 6, this additional firm characteristic would need to affect the relative price of foreign varieties viz-a-viz domestic inputs but should keep the relative efficiencies of foreign varieties unaffected. Suppose for example that the price-adjusted quality of foreign variety j of product k for firm i was given by $\tilde{\xi}_{jk}^i = \frac{\eta_{jk}}{p_{jk}(1+\tau_{jk})} \mu^i = \xi_{jk} \mu^i$ where μ^i denotes the additional firm characteristic. Then

³⁶These results are consistent with a negative selection bias. To see this consider the following example. Suppose our measure of productivity ($\hat{\varphi}$) was a noisy signal of true productivity, that is $\varphi = \hat{\varphi} + \epsilon$. If firms base their decisions on $\hat{\varphi}$, then high (measured) productivity firms have on average low ϵ realizations, once the sourcing strategy is controlled for.

³⁷When viewed through the lens of the model, the concentration of firms' expenditure shares across products and varieties documented above (Facts 3 and 4) are indicative of substantial price-adjusted quality differences (see (9)).

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A-Domestic	ln expenditure share on domestic inputs					
	[ln] mean = [-0.500] 0.700					
log Sales	0.016*** (0.001)		0.070*** (0.002)	0.099*** (0.010)		
log Avg. No of Var.		-0.275*** (0.004)	-0.349*** (0.004)	-0.155*** (0.006)	-0.149*** (0.006)	-0.149*** (0.006)
Exporter				0.143*** (0.021)	0.128*** (0.020)	0.129*** (0.020)
Corporate Group				0.014* (0.008)	0.013* (0.008)	0.010 (0.008)
Foreign Group				0.028** (0.013)	0.024* (0.013)	0.023* (0.013)
TFP-LP					0.028*** (0.006)	
TFP-OLS						0.028*** (0.007)
Inv. Mill's Ratio	0.176*** (0.004)	0.068*** (0.003)	0.147*** (0.004)	5.203*** (0.557)	4.781*** (0.551)	4.770*** (0.560)
Firm FE	N	N	N	Y	Y	Y
Observations	846,326	846,326	846,326	846,326	627,392	628,414
Panel B-Foreign	ln average expenditure share on top foreign variety					
	[ln] mean = [-0.114] 0.904					
log Sales	-0.027*** (0.000)		0.013*** (0.000)	0.007*** (0.002)		
log Avg. No of Var.		-0.243*** (0.001)	-0.258*** (0.001)	-0.245*** (0.002)	-0.244*** (0.002)	-0.243*** (0.002)
Exporter				(0.001)	(0.002)	(0.002)
Corporate Group				-0.004 (0.002)	-0.004 (0.002)	-0.004 (0.002)
Foreign Group				0.003* (0.003)	0.003* (0.003)	0.003* (0.003)
TFP-LP					0.003*** (0.001)	
TFP-OLS						0.003** (0.001)
Inv. Mill's Ratio	0.027*** (0.001)	-0.009*** (0.001)	0.006*** (0.001)	0.035 (0.103)	-0.030 (0.107)	-0.033 (0.108)
Firm FE	N	N	N	Y	Y	Y
Observations	858,394	858,394	858,394	858,394	637,780	639,016

Notes: This table reports the second stage of the estimator proposed by Heckman (1979). Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include year fixed effects and 3 digit industry fixed effects. The dependent variable is the log of the domestic expenditure share. "Log Avg. No of Var." is the firm-level average number of varieties across products, $\bar{V} = \sum_k V_k \omega_k$. TFP-OLS is calculated as the residual from an industry-specific OLS regression of log value added on log capital and log employment. TFP-LP is calculated using the method of Levinsohn and Petrin (2003). A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France. A firm is member of a corporate group if it is controlled by another firm or it has control over at least one affiliate. The excluded instrument in the first stage is the lagged import status (see Table 2).

Table 7: Domestic expenditure shares controlling for selection into importing

(15) shows that firm i 's relative price of foreign inputs is given by

$$\tilde{P}_F(V, \mu^i) = \left(\sum_k^K \left(\sum_{j \neq 1}^{V_k} \xi_{jk}^{\rho-1} \right)^{\frac{\varepsilon-1}{\rho-1}} \right)^{\frac{1}{1-\varepsilon}} (\mu^i)^{-1} = \frac{P_F(V)}{\mu^i}.$$

Due to the multiplicative formulation, the relative efficiency of foreign varieties viz-a-viz each other will be unaffected, but “efficient importers” (i.e. high- μ firms) will have a comparative advantage in sourcing internationally. This would generate a positive correlation between productivity and the domestic expenditure share conditional on the sourcing strategy V .³⁸ Note that this specification is a variation of the mechanism in KUGLER AND VERHOOGEN (2010).

A second route would follow the methodological approach of ARKOLAKIS (2008). In his work, exporting firms have to use resources to attract consumers. As more productive firms chose to cater to a bigger market, the reduced form of his model looks *as if* more productive firms face higher fixed costs of exporting. The analogy in our model would be a mechanism by which firms' behavior is reflected in the final price-adjusted qualities in such a way that more productive firms end up facing a higher relative price of foreign inputs. More theoretical and empirical research is needed to inform us about the underlying reason for the “excess” firm-level heterogeneity in domestic-foreign spending patterns.

2.5 Conclusion

The purpose of this paper is to propose a simple model of import demand, to test its qualitative predictions using firm-level data, and thus to isolate the aspects of the theory which need further refinements. The model is standard in that it relies on two core assumptions: productivity is the single source of firm-level heterogeneity and prices, fixed costs and input qualities are common across firms. The model predicts that more productive firms select into importing, import more products, and import more varieties of each product. Using a comprehensive dataset of French manufacturing firms, we show that all of these extensive margin predictions are borne out. On the intensive margin, the key prediction is that more productive firms should have lower expenditure shares on each variety of each product, but that, conditional on the firm's sourcing strategy, productivity (and in general any firm characteristic) should be irrelevant. While we do find evidence supporting this prediction among expenditure shares across foreign inputs, we reject the prediction for the domestic vs. foreign expenditure pattern. After controlling for the sourcing strategy, we find that more productive firms spend a higher share of their budget on domestic inputs. These results not only show that the core assumptions of the standard model need to be amended, but also suggest the particular direction in

³⁸Such a model would generate the empirical correlation between expenditure shares and firm-level productivity regardless of the correlation between φ and μ on the firm level. Efficient importers (high- μ firms) will have a lower productivity cut-off to start importing and will import more products and more varieties conditional on productivity. Hence, conditional on the sourcing strategies, high- μ firms will be (on average) less productive than their low- μ counterparts and will have lower domestic expenditure shares. Hence, conditional on the sourcing strategy, productivity and domestic expenditure shares are positively correlated irrespective of the cross-sectional distribution of the random vector (φ, μ) .

which to do so. Further research is required to achieve a better understanding of import demand.

2.6 Appendix

2.6.1 Data Description

Our main data set stems from the information system of the French custom administration (DGDDI) and contains the universe of import and export flows by French manufacturing firms. The data is collected at the 8-digit (NC8) level and a firm located within the French metropolitan territory must report this detailed information as long as the following criteria are met. Within EU imports, have to be reported as long as the firm's annual trade value exceeds 150,000 Euros. If that threshold is not met, firms can choose to report under a simplified scheme. However, in practice, many firms under that threshold report the detailed information. For imports from outside the EU, all shipments must be reported to the custom administration as this data is used to calculate the value added tax in all cases. The conditions are more stringent for exports. For within EU exports, all shipments must be reported to the custom administration. For exports outside the EU, reporting is required if the exported value to exceeds 1,000 Euros or weighs more than a ton.

The attractive feature of the French data is the presence of unique firm identifiers (the SIREN code), which is available in all French administrative files. Hence, various other datasets can be matched to the trade data at the firm level. To learn about the characteristics of the firms in our sample we employ fiscal files.³⁹ Sales are deflated using price indices of value added at the 3 digit level obtained from the French national accounts. To measure the expenditure on domestic inputs, we subtract the total import value from the total expenditure on wares and inputs reported in the fiscal files. Capital, used for the TFP estimation, was computed using a permanent inventory method. The series were initialized with the deflated value of assets reported in the first year of reported fiscal account (1995). We then used the reported investment expenditure, which we deflated with an investment price index available from the French national accounts. We assumed a depreciation rate of 10%.

Additionally we use the French business registers (SIRENE files), created by the Firm Demography Department of the French National Institute of Statistics (INSEE). The SIRENE files report the yearly creation and destruction of French firms and provide us with information about firm age and legal status. Finally we incorporate information on the ownership structure from the LIFI/DIANE (BvDEP) files. These files are constructed at INSEE using a yearly survey (LIFI) describing the structure of ownership of all of the French firms in the private sector whose financial investments in other firms (participation) are higher than 1.2 million Euros or having sales above 60 million Euros or more than 500 employees. This survey is complemented with the information about ownership structure available in the DIANE (BvDEP) files, which are constructed using the annual mandatory

³⁹The firm level accounting information is retrieved from two different files: the BRN ("Bénéfices Réels Normaux") and the RSI ("Régime Simplifié d'Imposition"). The BRN contains the balance sheet of all firms in the traded sectors with sales above 730,000 Euros. The RSI is the counterpart of the BRN for firms with sales below 730,000 Euros. Although the details of the reporting differs, for our purpose these two data sets contain essentially the same information. Their union covers nearly the entire universe of all French firms.

	Full Sample	Importers	Non-Importers	Exporters	Non-Exporters
Employment	18.18	89.72	5.71	78.89	5.9
Sales	4342.35	23646.8	969.15	20842	1035.52
Sales / Worker	104.42	157.62	92.3	150.46	92.3
Capital / Worker	33.74	44.28	31.29	42.45	31.38
Inv. / Worker	2.9	4.13	2.6	3.91	2.61
Inputs (mat.)	0.2	0.3	0.18	0.28	0.18
Import share	0.04	0.3	0	0.2	0.01
Share of Importers	0.15	1	0	0.66	0.05
Share of Exporters	0.17	0.75	0.07	1	0
Firm Age	14.38	19.45	13.51	19.54	13.36
Foreign owned	0.02	0.13	0.01	0.11	0.01
Foreign Group	0.05	0.23	0.01	0.2	0.02
Labor Productivity	43.783	56.496	40.726	56.023	40.405
TFP-LP	28.135	30.255	27.788	29.23	27.999
TFP-OLS	25.412	26.519	25.251	26.61	25.189
Number of Firms	259,602	31,022	228,580	34,527	225,075

Notes: Sales, wages, expenditures on imports or exports are all expressed in 2000 prices using a 3-digit industry level price deflator. Our capital measure is the book value reported in firms' balance sheets ("historical cost"). We measure employees by occupation. Skilled workers are engineers, technicians and managers, workers of intermediate skills are skilled blue and white collars and low skilled workers are members of unskilled occupations. A firm is foreign owned, if the controlling entity is a foreign company. A firm is member of a foreign group if at least one affiliate or the headquarter is located outside of France.

Table 8: Characteristics of importers, exporters and domestic firms.

reports to commercial courts, and with the register of firms that are controlled by the State.

Using these datasets, we construct a non-balanced panel dataset spanning the period from 2001 to 2006. Some basic characteristics of importing and non-importing firms are contained in Table 8. For comparison, we also report the results for exporting firms.

2.6.2 A Necessary Condition for Hierarchical Sourcing

We are going to describe the condition for $V(\varphi)$ to be increasing in φ , i.e. we are going to characterize the conditions such that a variety is sourced by firm φ' whenever it is imported by firm $\varphi < \varphi'$. Consider variety j of product k and suppose this is sourced by firm φ but not by φ' . Let $V_{-jk}(\varphi)$ be the vector of varieties sourced by φ excluding jk and $V_{+jk}(\varphi')$ the vector of varieties of φ' when jk is added. Then

$$A\varphi^{\sigma-1} \left[c(V(\varphi))^{1-\sigma} - c(V_{-jk}(\varphi))^{1-\sigma} \right] > f_{jk} > A\varphi'^{\sigma-1} \left[c(V_{+jk}(\varphi'))^{1-\sigma} - c(V(\varphi'))^{1-\sigma} \right].$$

Hence,

$$\left(\frac{\varphi'}{\varphi} \right)^{\sigma-1} < \frac{c(V(\varphi))^{1-\sigma} - c(V_{-jk}(\varphi))^{1-\sigma}}{c(V_{+jk}(\varphi'))^{1-\sigma} - c(V(\varphi'))^{1-\sigma}} = \left(\frac{c(V(\varphi))}{c(V(\varphi'))} \right)^{1-\sigma} \frac{\left(\frac{c(V(\varphi))}{c(V_{-jk}(\varphi))} \right)^{1-\sigma} - 1}{\left(\frac{c(V_{+jk}(\varphi'))}{c(V(\varphi'))} \right)^{1-\sigma} - 1}$$

A first order approximation around $\frac{c(V(\varphi))}{c(V_{jk}(\varphi))} = 1$ yields

$$\left(\frac{c(V(\varphi))}{c(V_{jk}(\varphi))} \right)^{1-\sigma} - 1 \approx \frac{1}{1-\sigma} \frac{c(V(\varphi)) - c(V_{jk}(\varphi))}{c(V_{jk}(\varphi))} = \frac{1}{1-\sigma} \Delta_{jk}(\varphi),$$

where $\Delta_{jk}(\varphi)$ is the percentage efficiency gain for firm φ to import variety jk . We then require that

$$\frac{\Delta_{jk}(\varphi)}{\Delta_{jk}(\varphi')} > \left(\frac{\varphi'}{\varphi} \right)^{\sigma-1} \left(\frac{c(V(\varphi))}{c(V(\varphi'))} \right)^{\sigma-1} = \left(\frac{\varphi'/c(V(\varphi'))}{\varphi/c(V(\varphi))} \right)^{\sigma-1} = \frac{S(\varphi')}{S(\varphi)} > 1, \quad (16)$$

where $S(\varphi)$ denotes firm φ 's sales. Hence, firm φ' also sources jk whenever the relative efficiency gain for firm φ does not exceed the relative sales, i.e. whenever the efficiency gains are not too unequal.

Chapter 3

Financial Frictions and Non-Balanced Growth

3.1 Introduction

The process of economic development is typically characterized by uneven rates of growth across sectors. The traditional literature, starting with CLARK (1940) and KUZNETS (1957), documents the change in the relative importance of major sectors - notably agriculture, manufacturing and services - along the development path of the economy. Several explanations have been put forward to account for this pattern of non-balanced growth. One group of theories has focused on differences in income elasticities across goods (KONGSAMUT, REBELO, AND XIE (2001), FOELLM AND ZWEIMULLER (2008)). Other theories have emphasized supply-side reasons for non-balanced growth. BAUMOL (1967) and NGAI AND PISSARIDES (2007) propose biased productivity growth, while ACEMOGLU AND GUERRIERI (2008) posit differences in factor proportions across sectors together with capital deepening.

In this paper, I provide evidence for an alternative form of non-balanced growth and propose a novel theory to account for it. On the empirical side, I show that sectors that rely more heavily on external finance exhibit faster output growth along the economy's development path. I also show that externally dependent sectors grow disproportionately faster in countries with better financial institutions. On the theory side, I argue that frictions in financial markets can account for both of these facts. I build a dynamic two-sector model where sectors differ in their liquidity requirements and agents are heterogeneous in their wealth holdings and face collateral constraints. In the model, non-balanced growth is a result of the financial friction. I show that the model can account for the documented faster output growth of externally dependent sectors and, under some conditions, for the disproportionate effect of financial development on industry growth rates of these sectors.

I use a panel of 69 countries over 26 years to document two facts on the pattern of industrial growth rates. First, I show that externally dependent sectors tend to grow at a faster rate along the economy's development path. Second, I show that externally dependent sectors grow disproportionately faster in financially developed countries.¹ The second fact is a variant of the main finding of RAJAN AND ZINGALES (1998). The first fact is, to the extent of my knowledge, a novel characteristic of the process of industrial development. I establish this fact at two different levels of sectoral aggregation. First, I divide manufacturing industries into two groups according to their external financial dependence and show that increases in a country's real per capita income are associated with increases in relative output of the more externally dependent sectors. Second, exploiting the

¹Alternatively, these facts can be expressed as follows. Consider the growth differential, defined as the output growth rate of high external dependence sector minus the growth rate of low external dependence sectors. Fact 1 states that the growth differential is positive. Fact 2 states that the growth differential is increasing in the country's level of financial development.

fully disaggregated sectoral data, I use a difference in difference strategy to show that increases in a country's growth rate of real per capita income are associated with increases in industry growth rates that are more pronounced for externally dependent sectors.

To jointly account for these facts, I propose a two-sector growth model whose main ingredient is the presence of financial market imperfections. In the model, there is a continuum of producer-consumer agents who differ in their wealth holdings. Agents need to decide in which of the two sectors to operate. The two sectors have identical technologies, except for a liquidity requirement that differs across sectors. Absent financial frictions, the economy exhibits balanced growth in its transition to the steady state. I then introduce a financial friction that affects the agents' ability to enter the more liquidity intensive sector. In particular, only agents with wealth greater than some threshold are able to enter this sector. When the mass of agents with wealth above this threshold is small enough, the economy is constrained and the optimal size of production units is distorted. As long as financial frictions bind, the liquidity-intensive sector grows faster than the other sector. The reason is that, as the economy develops, the agents are able to gradually overcome the friction in financial markets and migrate from the unconstrained to the constrained sector. Thus, financial frictions are a source of non-balanced growth via an extensive margin channel.

In this framework, it is not granted that an improvement in financial development leads to disproportionately higher growth in the more externally dependent sector.² The degree of excess growth of the liquidity-intensive sector depends crucially on the speed at which agents overcome financial constraints, as well as on the specific shape of the wealth distribution. Under the assumption of a constant savings rate, I find sufficient conditions on the wealth distribution and the parameters of the model under which financial development leads to disproportionately higher growth in the liquidity intensive sector. These conditions require that the savings rate, and the interest rate, must both be sufficiently low. A low interest rate means that the economy needs to be sufficiently constrained or, in other words, financial frictions need to be sufficiently high.

When financial frictions are not sufficiently high, financial development leads to a reduction in the degree of excess growth in externally dependent sectors. Eventually, for a sufficiently low degree of financial frictions, financial development has no effect on the growth differential. Thus, the model predicts an inverted U-shaped relationship between the level of financial development and the growth differential. I show that this prediction of the model is supported by the data.

Related Literature. Seminal empirical contributions to the literature on structural change - CLARK (1940), KUZNETS (1957), CHENERY (1960), SYRQUIN AND CHENERY (1975) - provide evidence for the hypothesis that, along an economy's process of development, there is substantial reallocation of resources and output between major sectors.³ In particular, these authors document a decrease in the importance of the agriculture sector and an increase in the importance of the manufacturing and services sectors, both in terms of employment and product shares, as countries

²In other words, the model is not consistent with Fact 2 and the main finding of RAJAN AND ZINGALES (1998) for all parameters.

³For a recent survey on structural change, see MATSUYAMA (2008).

develop. In this paper, I look at the change in the relative importance of different industries *within* the Manufacturing sector, focusing on the degree of external financial dependence as the industry characteristic of interest. In this sense, I provide evidence for a different kind of structural change.

On the methodological front, most of the previous empirical work on structural change builds on cross-country comparisons of average sectoral value added or employment shares, where the time dimension has been reduced to obtain a single observation per country - see KUZNETS (1957) and CHENERY (1960).⁴ Notable exceptions are SYRQUIN AND CHENERY (1975, 1989) who use panel data to regress various sectoral variables on income per capita and total population, allowing for country and some form of time fixed effects.⁵ In this paper, I propose an alternative methodology to study structural change, namely, the difference in difference strategy pioneered by RAJAN AND ZINGALES (1998). Specifically, by focusing on explanatory variables that vary with country, sector and time - i.e. an interaction term between the country's growth rate in real per capita income and the sector's external dependence - I am able to include country, sector and time fixed effects and improve the standard of identification.

The paper is also related to the theoretical literature on structural change. Most of the theories that have been put forward to account for non-balanced growth fall into either of two categories: demand or supply-side explanations. In the former, sectors with higher income elasticity become relatively more important as the economy develops - see KONGSAMUT, REBELO, AND XIE (2001) for a prominent example. In the latter class of theories, non-balanced growth follows from either differential productivity growth (NGAI AND PISSARIDES (2007)) or factor-proportion differences (ACEMOGLU AND GUERRIERI (2008)) across sectors. In this paper, I propose a third category: frictions to trade in financial markets. In my theory, as in ACEMOGLU AND GUERRIERI (2008), technology differs across sectors but, absent financial frictions, the economy exhibits balanced growth. In this sense, non-balanced growth is a direct consequence of the friction in the market for capital.

3.2 Empirical Facts

In this section, I document two facts on the pattern of cross-industry growth rates. First, I show that sectors that rely more heavily on external finance exhibit faster output growth along the economy's development path. Second, I show that externally dependent sectors grow disproportionately faster in countries with better financial institutions. I establish these facts using a panel of 69 countries for 26 years, with data for 15 manufacturing sectors per country.

I provide evidence for the faster output growth of externally dependent sectors along the economy's development path - henceforth Fact 1- on two levels of sectoral aggregation. First, at the country level, I study the evolution of the ratio of output in high external dependence sectors to

⁴KUZNETS (1957) presents two forms of descriptive statistics: (a) an international comparison of value added and employment shares of major sectors, where each country's share is a 5-year average, and (b) a longer-term analysis for fewer countries, where he shows time-averages for different subperiods, for each country. CHENERY (1960) runs cross-country regressions of sectoral value added shares on income per capita and total population. The time dimension is eliminated by taking time-averages.

⁵More recently, KONGSAMUT, REBELO, AND XIE (1997) regress sectoral labor shares on income per capita, but do not include country nor time fixed effects.

output in low external dependence sectors. I show that relative output in externally dependent sectors tends to co-move with real per capita income over time. Second, at the country-sector level, I show that growth in a country's real per capita income is associated with disproportionately higher industry output growth in externally dependent sectors. Thus, the evidence suggests that economic development, as measured by growth in real per capita income, is accompanied by faster growth of externally dependent sectors.

I provide evidence for the positive effect of financial development on the degree of excess output growth of externally dependent sectors - henceforth Fact 2 - by following the strategy in RAJAN AND ZINGALES (1998). Specifically, I consider a cross-section of industry output growth rates between 1980 and 1989. I show that higher initial financial development is associated with higher subsequent output growth, and the effect is stronger for sectors that are more externally dependent.

Data Sources

I use data on value added and quantity indices of industrial production from the Industrial Statistics Yearbook, compiled by the United Nations Statistical Division (1993) - henceforth UNSD. The UNSD provides data for a wide cross section of countries and industries between 1967 and 1991.

Data on financial development is obtained from BECK, DEMIRGÜÇ-KUNT, AND LEVINE (2000). I focus on two measures of financial development: (i) the ratio of private credit by deposit money banks and other financial institutions to GDP, and (ii) the ratio of stock market capitalization to GDP. The first measure is constructed with raw data from the IMF's *International Financial Statistics*, while the second measure uses data from Standard and Poor's *Emerging Market Database* and *Emerging Stock Market Factbook*.

Data on real income per capita is taken from Penn World Tables. In particular, I use the chain series of PPP converted GDP per capita, at 2005 constant prices.

Data on external dependence for the 3-digit ISIC sectors during the 1980s is taken from RAJAN AND ZINGALES (1998) - henceforth RZ. They use firm-level data on publicly traded US firms from Compustat (1994) and measure a firm's dependence on external finance as the fraction of capital expenditures that is not financed with internal cashflows from operations.

The final sample consists of 69 countries, which are listed in Table 1 in the Appendix.

Fact 1: Growth in real per capita income is associated with faster output growth in externally dependent sectors

In this subsection, I show that overall development of the economy, as measured by growth in real per capita income, is characterized by faster output growth in externally dependent sectors. I provide evidence for this fact on two levels. First, at the country level, I show that relative output in externally dependent sectors tends to co-move with real per capita income. Second, at the country-sector level, I show that increases in a country's growth rate of real per capita income are associated with increases in industry output growth rates that are more pronounced for externally dependent sectors.

I start by dividing manufacturing industries into two groups according to their degree of external financial dependence. For each group, I compute a weighted average of the industrial production indices of the corresponding sectors in the group. I weight each index of industrial production by the sector's value added share within the group.⁶ Let \bar{Q}_{mkt} be the average index of industrial production in group $m \in \{L, H\}$, in country k at time t . I then define relative output in externally dependent sectors as $\bar{Q}_{Hkt}/\bar{Q}_{Lkt}$.

To get a visual sense of Fact 1, Figures 1 and 2 show the evolution of this ratio for 12 countries in the sample between 1967 and 1991. Additionally, the Figures show the evolution of real per capita income for each country. A clear pattern emerges: in periods when real per capita income tends to grow, relative output in externally dependent sectors also tends to grow; in periods when real per capita income tends to fall, relative output also tends to fall. In other words, real per capita income and relative output in externally dependent sectors tend to co-move, over time and for each country.

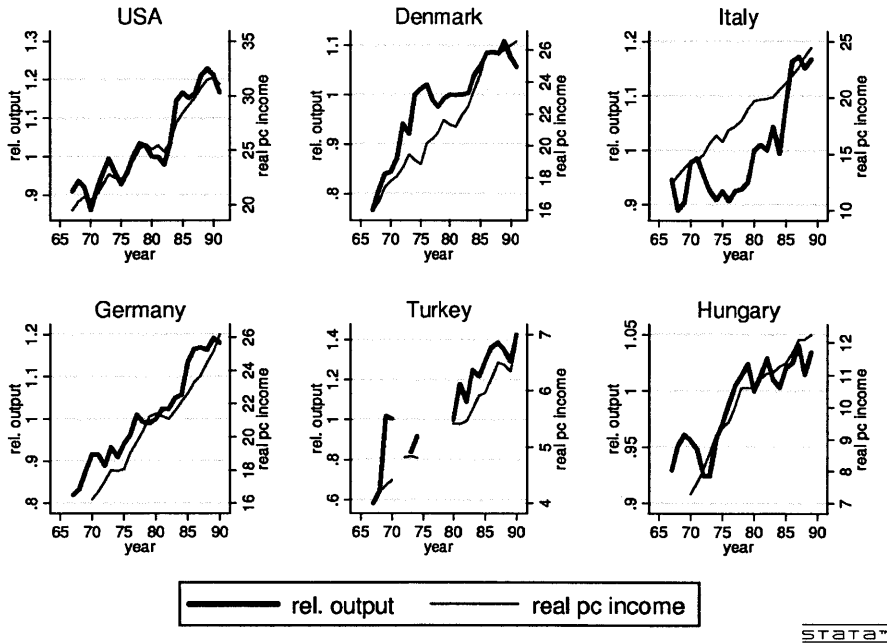


Figure 1: Relative Output in Externally Dependent Sectors, 1967-1991, Selected Countries

⁶More specifically, let Q_{jkt} and VA_{jkt} be the index of industrial production and value added, respectively, in sector j of country k at time t . Then, the average index in group $m \in \{L, H\}$ is constructed as:

$$\bar{Q}_{mkt} = \sum_{j \in m} \frac{VA_{jkt}}{\sum_{j \in m} VA_{jkt}} Q_{jkt}$$

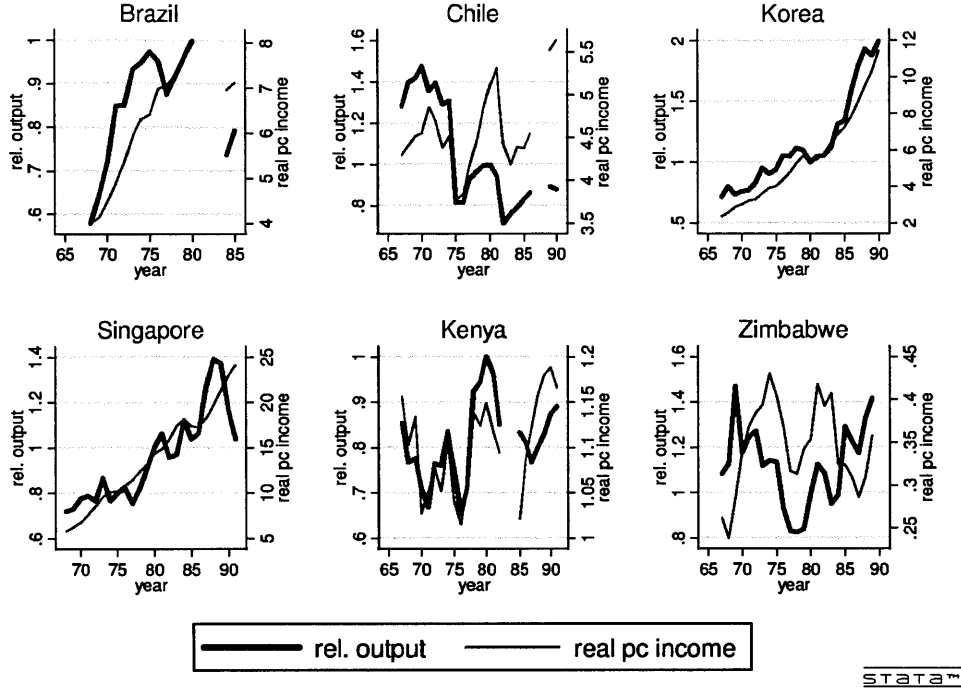


Figure 2: Relative Output in Externally Dependent Sectors, 1967-1991, Selected Countries

Next, I evaluate whether the pattern suggested by Figures 1 and 2 holds in the entire sample. Using the panel of 69 countries and 26 years per country, I test whether increases in real per capita income are associated with increases in relative output in externally dependent sectors. To do so, I run the following specification at the country level:

$$\bar{Q}_{Hkt}/\bar{Q}_{Lkt} = \alpha + \alpha_k + \alpha_t + \beta_1 RGDP_{kt} + \varepsilon_{kt},$$

where $RGDP_{kt}$ denotes real per capita GDP in country k at time t , and α_k and α_t denote country and sector fixed effects, respectively. Table 1 contains the results. We see that real per capita GDP is positively associated with relative output in externally dependent industries. This suggests that economic development, as captured by growth in real income per capita, is accompanied by a bias in industrial production towards sectors that rely more heavily in external finance.

Dep. var.	Relative Output in Externally Dependent Sectors	
	(1)	(2)
Real Per Capita GDP	0.0245*** (0.0024)	0.0227*** (0.0039)
Country FE	Y	Y
Time FE	N	Y
Observations	1,113	1,113
R2	0.4757	0.4931

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the ratio of average output in high external dependence industries to average output in low external dependence industries. Index numbers of industrial production and value added at sector level are taken from the Industrial Statistics Yearbook compiled by the United Nations Statistics Division. The analysis is restricted to manufacturing sectors. Sectors are classified into high and low external financial dependence using the notion developed by Rajan and Zingales (1998). The coefficients estimates and standard errors were multiplied by 1000.

Table 1: Non-Balanced Growth: Relative Output in Externally Dependent Sectors

Finally, I show that this pattern is not an artifact of the aggregation into two sectors but is also present at the country-sector level. To see this, I run the following specification:

$$g_{jkt} = \alpha + \alpha_j + \alpha_k + \alpha_t + \beta_1 G_{kt} + \beta_2 G_{kt} ed_j + \varepsilon_{kt},$$

where g_{jkt} is the annual growth rate in the industrial production index of sector j in country k at time t , G_{kt} is the annual growth rate in real per capita GDP in country k at time t , and ed_j is the degree of external financial dependence of sector j . Table 2 contains the results. The positive and significant coefficient estimate for G_{kt} captures the mechanical relation between the country's overall performance and output growth in manufacturing industries. The positive and significant coefficient estimate for the interaction term captures the non-balanced nature of economic growth. Increases in the rate of growth of a country's real per capita income are associated with increases in output growth of manufacturing industries, and these increases are more pronounced for externally dependent sectors.

Dep. var.	Industry Output Growth		
	(1)	(2)	(3)
Growth Rate	0.7140*** (0.0416)	0.5826*** (0.0427)	0.6255*** (0.0449)
Growth Rate x Ext Dep	0.8810*** (0.0951)	0.8806*** (0.0921)	0.6889*** (0.1142)
Country FE	Y	Y	Y
Time FE	N	Y	Y
Sector FE	N	N	Y
Observations	17,719	17,719	17,719
R2	0.1500	0.1692	0.1782

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the growth rate in the quantity index of industrial production at the sector level. 'Growth rate' stands for the yearly growth rate in real per capita GDP at the country level. 'Ext Dep' stands for the industry's degree of external financial dependence, as constructed by Rajan and Zingales (1998). Index numbers of industrial production are taken from the Industrial Statistics Yearbook compiled by the United Nations Statistics Division. The analysis is restricted to manufacturing sectors. Data for real per capital GDP is taken from Penn World Tables.

Table 2: Non-Balanced Growth: Industry Growth Rates

Fact 2: Financial development is associated with disproportionately faster output growth in externally dependent sectors

In this subsection, I show that industrial sectors that are relatively more in need of external finance grow disproportionately faster in countries with more developed financial institutions. To do so, I use the difference-in-difference methodology of RAJAN AND ZINGALES (1998), which consists of estimating the following specification:

$$g_{jk} = \alpha + \alpha_j + \alpha_k + \beta \text{ext}_j \lambda_k + \varepsilon_{jk}, \quad (1)$$

where g_{jk} is the annual compounded rate of growth in output in sector j in country k for the period 1980-1989 and λ_k is a measure of country k 's financial development. The advantage of this approach is the inclusion of sector and country fixed effects, which helps alleviate potential bias from omitted sector-specific and country-specific variables.

Table 3 contains the results. Column (1) uses the ratio of private credit to GDP while column (2) uses the ratio of stock market capitalization to GDP as a measure of the country's level of financial development. In both cases, the coefficient estimate for the interaction term comes out positive and significant. This indicates that financial development is associated with disproportionately higher output growth in externally dependent industries.

The estimated coefficients imply that the industry at the 75th percentile of external dependence should grow 0.48 percentage points faster than the industry at the 25th level when it is located in a country at the 75th percentile of financial development rather than in one at the 25th percentile. For comparison, the rate of growth in industry output is about 2 percent per year, on average.

Dep. var.	Annual Growth Rate in Output	
	(1)	(2)
Ext Dep x Priv Credit	0.0313** (0.0146)	
Ext Dep x MktCap		0.0264** (0.0108)
Country and Sector FE	Y	Y
Observations	1053	815
R2	0.4174	0.5263
Differential in Real Growth	0.4835	0.4476

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the annual compounded growth rate in output for the period 1980-1989 for each ISIC industry in each country. The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by Rajan and Zingales (1998). The variable "Priv Credit" stands for the ratio of private credit by deposit money banks and other financial institutions to GDP. "MktCap" stands for the ratio of stock market capitalization to GDP. Both financial development measures are taken from Beck, Demirgüç-Kunt, and Levine (2000). The differential in real growth measures how much faster an industry at the 75th percentile level of external dependence grows with respect to an industry at the 25th percentile level when it is located in a country at the 75th percentile of financial development rather than in one at the 25th percentile.

Table 3: Financial Development and Industry Growth

Note that the results in Table 3 do not imply that external financial dependence is associated with faster output growth. A positive coefficient on the interaction term in equation (1) means that financial development is associated with an increase in the degree of *excess* growth in externally dependent sectors. It does not mean that such excess growth is positive, i.e. that externally dependent sectors grow faster. This latter feature was established in the previous subsection - see Fact 1.

There are two important differences between the results contained in Table 3 and the ones in RAJAN AND ZINGALES (1998). First, I focus on growth in fixed-price quantity indices while RZ focus on growth in value added. Second, RZ control for the industry's share in manufacturing value added in 1980 while I exclude this variable from the analysis.

3.3 A Model of Frictions to Entry

In this section, I propose a theory based on financial frictions to explain the facts documented above. In particular, I explore a two-sector Solow growth model in which liquidity is required to start production and sectors differ in their liquidity requirements. I study financial frictions that hinder the ability of agents to gather liquidity and therefore enter the liquidity-intensive sector. I show that, absent financial frictions, the economy exhibits balanced growth along the transition to the steady state. With frictions in financial markets, the liquidity intensive sector grows faster as the economy develops. This happens because agents gradually overcome the friction in financial markets and migrate from the low to the high-liquidity intensive sector, giving the latter an extra source of growth. Thus, in this theory, non-balanced growth emerges as a consequence of financial frictions.

The model delivers the positive co-movement between real per capita GDP and relative output in externally dependent sectors documented in Fact 1 of the previous Section. Along the economy's development path, both variables tend to grow. I also study the effect of financial development on the differential of growth rates across sectors. I find conditions on the distribution of wealth and other parameters such that financial development leads to a disproportionate increase in the growth rate of the liquidity-intensive sector, as documented in Fact 2 of the previous Section. In general, the model predicts an inverted U-shaped relationship between financial development and the degree of excess growth in the liquidity intensive sector. I show that this prediction is supported by the data.

3.3.1 Basic Environment

Consider a dynamic economy with three sectors: a final good and two intermediate inputs. The final good can be either consumed or used as capital to produce intermediates. The intermediate inputs, which are non-storable, are used for the production of the final good.

There is a unit mass of producer-consumer entrepreneurs who are endowed with physical capital, or wealth, and labor. I assume that all agents are endowed with one unit of time and that initial wealth is the only source of heterogeneity across agents. I denote initial wealth by ω_0 and its distribution by $G_0(\omega_0)$. The dynamic behavior of entrepreneurs is characterized by a linear savings rule: in each period, agents consume a fraction $1 - s$ of their end-of-period wealth, where $s \in (0, 1)$.

The final good is produced with the following production function:

$$y = y_1^{\gamma_1} y_2^{\gamma_2}$$

where y_i denotes the amount of intermediate good $i = 1, 2$ used in final good production. I assume that the final good technology is subject to decreasing returns, i.e. $\gamma_1 + \gamma_2 < 1$.

The two intermediate inputs are produced with the following technology: $f_i(k) = A_i k^\alpha$ for $i = 1, 2$, where $\alpha \in (0, 1)$, A_i is sector-specific productivity, and k denotes units of capital used. Sector 2 further requires a fixed amount of resources, $f > 0$ units of the final good, to start production. These resources are not actually used as capital in the production process. Thus, f can be interpreted as

a liquidity requirement and sector 2 as more *liquidity intensive* than sector 1.⁷

Finally, I assume that production of the final good is done by a single external firm whose profits are equally distributed to all entrepreneurs. That is, entrepreneurs cannot enter the final good sector. This assumption simplifies the analysis, as entrepreneurs need only decide between two sectors instead of three.

At the beginning of the period, agents choose an intermediate sector to operate a firm. Then, a market for capital meets where agents trade claims on two types of loans: (i) loans destined to cover the liquidity requirement and (ii) loans for working capital. The first type of agreements is done between entrepreneurs and an external agent who offers liquidity at no cost.⁸ However, trades of this type are subject to a friction: an agent with wealth ω cannot borrow more than $\lambda\omega$ from the external agent, where $\lambda \geq 1$ is a parameter that captures the degree of financial development of the economy. The second type of agreements consists of loan contracts between entrepreneurs, in which units of the final good are exchanged for the duration of the period at an interest rate of r . There are no frictions for this type of loans.

The particular form of financial friction assumed results in a very simple reduced form friction: only agents with wealth $\omega \geq f/\lambda$ can enter into sector 2. Conditional on entry, capital markets are perfect: all agents are borrow and lend as much as desired. Thus, this model focuses on the bite that financial frictions have in restricting entry into sectors which require more liquidity for production.

3.3.2 Equilibrium

In this section, I study the behavior of entrepreneurs and the final good firm, and define the equilibrium. The next two sections characterize the equilibrium and establish the main results of the paper.

Problem of entrepreneurs. Entrepreneurs' (static) production decisions are dissociated from their (dynamic) consumption/savings decisions. As producers they decide in which intermediate sector to operate and how much output to produce (and thus how much capital to use). As consumers, they decide how much of the final good (i.e. capital) to consume and how much to save for next period. Let's first study their static production problem. Conditional on entry into sector i , all agents are identical and solve the following problem:

$$\pi_i^* = \max_{k_i} p_i A_i k_i^\alpha - (r + \delta)k_i = (\alpha^{-1} - 1) \left(\frac{\alpha A_i p_i}{(r + \delta)^\alpha} \right)^{\frac{1}{1-\alpha}} \quad (2)$$

⁷To simplify the characterization of the equilibrium in the next section, I further assume that the resources used to meet the liquidity requirement are immediately available for an alternative use after entry into sector 2. In other words, entrepreneurs are able to immediately lend the resources used for liquidity purposes and earn interest on them.

⁸The assumption that liquidity loans entail no interest is done for simplicity. Technically, interest payments on these loans are negligible since the funds are needed only for an instant of time.

where the optimal scale of the firm is given by

$$k_i^* = \left(\frac{\alpha A_i p_i}{r + \delta} \right)^{\frac{1}{1-\alpha}}$$

Entrepreneurs with wealth $\omega < f/\lambda$ have no choice but to go to sector 1. Entrepreneurs with wealth $\omega \geq f/\lambda$ can enter into either sector and will choose the one with highest profits. Thus, assuming that all capital is borrowed, profits from production are:

$$\pi(\omega; p_1, p_2, r) = \max \{ \pi_1^*, I(\omega \geq f/\lambda) \pi_2^* \},$$

where $I(\omega \geq f/\lambda)$ is an indicator function that takes the value of 1 when $\omega \geq f/\lambda$.

After production is done, agents save a constant fraction s of their end-of-period wealth, so that the law of motion for wealth is:

$$\omega_{t+1} = s(1 + r_t)\omega_t + s \max \{ \pi_{1t}^*, I(\omega_t \geq f/\lambda) \pi_{2t}^* \} + s \pi_{FGt}^*, \quad (3)$$

where π_{FG}^* are the rebated profits from the final good firm. I now specify the problem of the final good firm. Recall that I have assumed that all production of the final good is done by a single firm.

Problem of final good firm. The firm operating in the final good sector solves the following problem:

$$\pi_{FG}^* = \max_{y_1, y_2} y_1^{\gamma_1} y_2^{\gamma_2} - p_1 y_1 - p_2 y_2 = (1 - \gamma_1 - \gamma_2) \left(\frac{\gamma_1^{\gamma_1} \gamma_2^{\gamma_2}}{p_1^{\gamma_1} p_2^{\gamma_2}} \right)^{\frac{1}{1-\gamma_1-\gamma_2}}, \quad (4)$$

where I have normalized the price of the final good to unity. This problem yields input demands given by:

$$y_1^* = \left(\frac{\gamma_1^{1-\gamma_2} \gamma_2^{\gamma_2}}{p_1^{1-\gamma_2} p_2^{\gamma_2}} \right)^{\frac{1}{1-\gamma_1-\gamma_2}}$$

$$y_2^* = \left(\frac{\gamma_1^{\gamma_1} \gamma_2^{1-\gamma_1}}{p_1^{\gamma_1} p_2^{1-\gamma_1}} \right)^{\frac{1}{1-\gamma_1-\gamma_2}}$$

I now define the equilibrium of this economy. Given the assumption of perfect capital markets after entry, a key equilibrium object is the mass of agents allocated to sector 1 at time t , which I denote by μ_t .

Definition. Given an initial distribution of wealth $G_0(\omega)$, a competitive equilibrium is a sequence of prices $\{p_{1t}, p_{2t}, r_t\}_{t=0}^{\infty}$, allocation of agents $\{\mu_t\}_{t=0}^{\infty}$, and a sequence of wealth distributions $\{G_{t+1}(\omega)\}_{t=0}^{\infty}$ such that

1. Given prices p_{1t}, p_{2t}, r_t , static production decisions are done optimally, that is, π_{1t}^*, π_{2t}^* and π_{FGt}^* satisfy (2) for $i=1,2$ and (4), respectively.

2. Markets clear at every period t :

(a) Capital market:

$$\mu_t \left(\frac{\alpha A_1 p_{1t}}{r_t + \delta} \right)^{\frac{1}{1-\alpha}} + (1 - \mu_t) \left(\frac{\alpha A_2 p_{2t}}{r_t + \delta} \right)^{\frac{1}{1-\alpha}} = \mathbb{E}[G_t(\omega)] \quad (5)$$

(b) Intermediate good 1:

$$\left(\frac{\gamma_1^{1-\gamma_2} \gamma_2^{\gamma_2}}{p_1^{1-\gamma_2} p_2^{\gamma_2}} \right)^{\frac{1}{1-\gamma_1-\gamma_2}} = \mu_t A_1 \left(\frac{\alpha A_1 p_{1t}}{r_t + \delta} \right)^{\frac{\alpha}{1-\alpha}} \quad (6)$$

(c) Intermediate good 2:

$$\left(\frac{\gamma_1^{\gamma_1} \gamma_2^{1-\gamma_1}}{p_1^{\gamma_1} p_2^{1-\gamma_1}} \right)^{\frac{1}{1-\gamma_1-\gamma_2}} = (1 - \mu_t) A_2 \left(\frac{\alpha A_2 p_{2t}}{r_t + \delta} \right)^{\frac{\alpha}{1-\alpha}} \quad (7)$$

(d) Either:

- i. $A_1 p_{1t} = A_2 p_{2t}$ and $\mu_t \geq G_t(f/\lambda)$ (unconstrained static equilibrium)
- ii. $A_1 p_{1t} < A_2 p_{2t}$ and $\mu_t = G_t(f/\lambda)$ (constrained static equilibrium)

3. The distribution of wealth evolves according to

$$G_{t+1}(\omega) = \int_{\{z: \omega_{t+1}(z) \leq \omega\}} dG_t(z)$$

where $\omega_{t+1}(z)$ is given by (3).

The constraint that agents need to be above a wealth threshold f/λ to enter sector 2 translates into an aggregate constraint that the mass of agents allocated to sector 2 in equilibrium cannot exceed the mass of agents whose wealth is above the threshold, that is $1 - \mu_t \leq 1 - G_t(f/\lambda)$, or simply $\mu_t \geq G_t(f/\lambda)$. Given $(\mathbb{E}[G_t(\omega)], G_t(f/\lambda))$, market clearing conditions and either profit equalization or the binding aggregate constraint pin down current prices and the allocation of agents to sectors, $\{p_{1t}, p_{2t}, r_t, \mu_t\}$. Note that the pair $(\mathbb{E}[G_t(\omega)], G_t(f/\lambda))$ resembles a pair of “moments” of the wealth distribution, where the second “moment” is affected by the parameter of financial development and the fixed cost.

3.3.3 Non-Balanced Growth

In this section, I establish a central result of the paper, namely, that financial frictions are a source of non-balanced growth across sectors. To do so, I first characterize the static equilibrium, i.e. the equilibrium for a given distribution of wealth. In particular, I obtain expressions for output in the different sectors as a function of aggregate wealth and the mass of agents with wealth below the threshold. I then show that, in a transition path where financial frictions bind and the mass of

constrained agents decreases, output in the liquidity-intensive sector grows relatively faster. At the same time, average wealth increases over time. Thus, the model is consistent with the documented positive co-movement between real per capita GDP and relative output in the externally dependent sector - see Fact 1 of the previous section.

I start by defining a *static* equilibrium as an equilibrium given $\mathbb{E}[G_t(\omega)]$ and $G_t(f/\lambda)$. From now on, I denote by x_t the mass of agents with wealth lower than the threshold, i.e. $x_t \equiv G_t(f/\lambda)$. The static equilibrium is *unconstrained* whenever:

$$\frac{\gamma_1}{\gamma_1 + \gamma_2} \geq x_t \quad (8)$$

Claim 1. In an *unconstrained static equilibrium*, the following properties hold:

1. The share of agents assigned to sector 1 is given by:

$$\mu_t = \frac{\gamma_1}{\gamma_1 + \gamma_2}$$

2. Entrepreneurs achieve the first-best scale in both sectors:

$$k_{1t} = k_{2t} = \mathbb{E}[G_t(\omega)]$$

3. Profits are equalized across sectors, $A_1 p_{1t} = A_2 p_{2t}$

4. All prices, p_{1t} , p_{2t} and r_t are decreasing in mean wealth, $\mathbb{E}[G_t(\omega)]$.

5. Sectoral output levels are given by:

$$Q_{1t} = \frac{\gamma_1}{\gamma_1 + \gamma_2} A_1 \mathbb{E}[G_t(\omega)]^\alpha \quad (9)$$

$$Q_{2t} = \frac{\gamma_2}{\gamma_1 + \gamma_2} A_2 \mathbb{E}[G_t(\omega)]^\alpha$$

See Appendix for a proof. Thus, when the mass of agents with wealth above the threshold is large enough, the production side of the economy is as in the frictionless economy. Note that x_t is irrelevant when (8) holds.

When condition (8) fails to hold, we have a *constrained* static equilibrium and the mass of agents allocated to sector 2 is as high as possible:

$$\mu_t = G_t(f/\lambda)$$

Claim 2. In an *constrained static equilibrium*, the following properties hold:

1. The share of agents assigned to sector 1 is larger than the optimal:

$$\mu_t = x_t > \frac{\gamma_1}{\gamma_1 + \gamma_2} \quad (10)$$

2. Firm size is distorted. In particular, sector 1 is smaller and sector 2 is larger when compared to their respective first best values:

$$k_{1t} = \frac{\gamma_1}{\gamma_1 + \gamma_2} \frac{\mathbb{E}[G_t(\omega)]}{x_t} < \mathbb{E}[G_t(\omega)]$$

$$k_{2t} = \frac{\gamma_2}{\gamma_1 + \gamma_2} \frac{\mathbb{E}[G_t(\omega)]}{1 - x_t} > \mathbb{E}[G_t(\omega)]$$

3. Sector 2 exhibits higher profits, $A_2 p_{2t} > A_1 p_{1t}$.
4. All prices p_{1t} , p_{2t} and r_t are decreasing in mean wealth $\mathbb{E}[G_t(\omega)]$. Furthermore, p_{1t} is decreasing in x_t , p_{2t} is increasing in x_t , and r_t is decreasing in x_t . Comparing these prices to their first best levels, we have that p_{2t} is larger, p_{1t} is smaller, and r_t is smaller.⁹ Finally, profits in sector 1 and the final good sector are decreasing in x_t , while profits in sector 2 are increasing in x_t .
5. Sectoral outputs are given by:

$$Q_1 = A_1 \left(\frac{\gamma_1}{\gamma_1 + \gamma_2} \mathbb{E}[G_t(\omega)] \right)^\alpha x_t^{1-\alpha} \quad (11)$$

$$Q_2 = A_2 \left(\frac{\gamma_2}{\gamma_1 + \gamma_2} \mathbb{E}[G_t(\omega)] \right)^\alpha (1 - x_t)^{1-\alpha} \quad (12)$$

Note that aggregate production at the sector level turns out to be a Cobb-Douglas production function on total capital and labor assigned to the sector. We can use Claims 1 and 2 to preview the dynamic behavior of the economy, by studying the effects of exogenous changes in the two relevant “moments” of the distribution of wealth on the static allocation. Claim 1 implies that, when the friction in financial markets does not bind, the economy exhibits balanced growth across sectors along its development path. Claim 2 implies that, when the friction binds, the economy exhibits *non-balanced growth* along its development path. The following proposition contains these results.

Proposition 1. When financial frictions do not bind, the two intermediate sectors grow at the same rate, equal to the rate of growth of average wealth. When financial frictions bind and the mass of agents with wealth below the threshold changes over time, the economy exhibits non-balanced growth across sectors. In particular, negative growth in the mass of agents with wealth below the threshold leads to faster output growth in sector 2 relative to sector 1.

⁹Consistent with other models with frictions in the capital market, the constrained static equilibrium features a *depressed* interest rate.

Proof. The proof relies on Claims 1 and 2. Consider how the quantities produced in the static equilibrium react to exogenous changes in the two moments of the wealth distribution. Applying a total differential to equation (9), sectoral growth rates when financial frictions do not bind are:

$$g_1 = g_2 = \alpha g \quad (13)$$

where g_i is the growth rate of Q_i , and g is the growth rate of average wealth. Applying a total differential to equation (11), sectoral growth rates when financial frictions bind are:

$$g_1 = \alpha g + (1 - \alpha)g_x \text{ and } g_2 = \alpha g - (1 - \alpha)\frac{x}{1 - x}g_x \quad (14)$$

where g_x is the growth rate of the mass of agents with wealth below the threshold. The degree of excess growth in sector 2 is:

$$\Delta g \equiv g_2 - g_1 = -(1 - \alpha)\frac{g_x}{1 - x} \quad (15)$$

It follows that $g_x \neq 0$ implies $\Delta g \neq 0$, i.e. non-balanced growth. Furthermore, $\text{sign}(\Delta g) = -\text{sign}(g_x)$ ■

Proposition 1 establishes that financial frictions are a source of non-balanced growth across sectors. A natural case to consider is a development path in which aggregate wealth increases and the mass of agents with wealth below the threshold decreases over time.¹⁰ I will refer to these transitional dynamics as a *typical development path*. Proposition 1 establishes that along a typical development path with binding financial frictions output sector 2 grows faster than output in sector 1. At the same time, the increase in aggregate wealth and the reduction in the mass of constrained agents imply that real per capita GDP increases along a typical development path. Thus, the model predicts a positive co-movement between real per capita GDP and relative output in the liquidity-intensive sector along a typical development path. To relate this prediction to Fact 1 of the previous section, we need to assess whether sector 2 is indeed the more externally dependent sector when financial frictions bind.

It turns out that, in the constrained static equilibrium, the liquidity-intensive sector is not necessarily the more externally dependent sector. This is because both capital expenditures and aggregate wealth are higher in this sector. The next subsection derives a condition under which sector 2 is more externally dependent. This condition takes the form of a stronger version of equation (10), the condition that ensures that financial frictions bind in the static equilibrium.

External financial dependence. In order to map the model to the data, we need a notion of external financial dependence in the model. In the data, the degree of external financial dependence is computed as the fraction of capital expenditures that is not financed with internal cashflows. Internal cashflows are used to capture the amount of internal resources that the firm can spend on inputs without resorting to credit. Thus, the corresponding notion of internal cashflows in the model is given by the amount of wealth held by the entrepreneur running the firm. In this way, firm ω 's

¹⁰This model features no growth in the steady state. To reconcile the model with the fact that most countries exhibit non-zero growth rates, we need to assume that in reality countries are transitioning to their steady states.

degree of external financial dependence, when operating in sector i , is:

$$efd_i(\omega) = \frac{k_i - \omega}{k_i} = 1 - \frac{\omega}{k_i}$$

The average degree of external financial dependence in each sector is then given by:

$$EFD_1 = 1 - \frac{\int_{\{\omega < f/\lambda\}} \omega dG(\omega)}{\mu k_1} \text{ and } EFD_2 = 1 - \frac{\int_{\{\omega \geq f/\lambda\}} \omega dG(\omega)}{(1-\mu)k_2}$$

Thus, the condition for sector 2 to be more externally dependent is:

$$\int_{\{\omega \geq f/\lambda\}} \omega dG(\omega) < \frac{\gamma_2}{\gamma_1} \int_{\{\omega < f/\lambda\}} \omega dG(\omega) \quad (16)$$

This condition requires that the group of agents in sector 2 holds a sufficiently small fraction of total wealth or that γ_2/γ_1 is high enough. Intuitively, sector 2 is more externally dependent if the firms in this sector have few internal resources (i.e. wealth) and/or if capital expenditures are relatively large in this sector (high γ_2/γ_1). It turns out that, as long as there is some degree of inequality in the distribution of wealth, condition (16) is stronger than condition (10).

Claim 3 . When the Lorenz curve of $G(\omega)$ is below the line of perfect equality at $\omega = f/\lambda$, then condition (16) implies condition (10).

See the Appendix for a proof. Intuitively, (16) requires that the fraction of total wealth held by the group of agents in sector 1 is sufficiently large. When the distribution of wealth is not perfectly egalitarian, the fraction of agents in group 1 is always larger than the fraction of wealth they have.

To summarize, if the economy is constrained along a typical development path, in the sense that condition (16) holds, then the model predicts the positive co-movement between real per capita GDP and relative output in externally dependent sectors observed in the data - see Fact 1 of the previous section.

3.3.4 The Effects of Financial Development

In this section, I study the effect of financial development on cross-sector output growth rates. In particular, I identify conditions under which the model is able to come to terms with Fact 2 of the previous section, namely, the positive effect of financial development on the degree of excess output growth of externally dependent sectors.

The assumption of a constant savings rate implies that I can obtain closed-form expressions for sector-level output growth rates between any two consecutive periods, as functions of the distribution of wealth in the first of the two periods and parameters. In this way, I can bypass the computation of the entire transition to the steady state, and simply focus on any two consecutive periods.¹¹

¹¹It should be noted that the steady state of this economy depends on initial conditions. This is due to the presence of a technological non-convexity together with financial market frictions, as in GALOR AND ZEIRA (1993). Depending on initial conditions, the economy converges either to a first best, unconstrained steady state where all agents have

In what follows, I define the *growth differential* to be the degree of excess growth in the liquidity-intensive sector. When considering discrete periods of time, it is convenient to work with the following measure of the growth differential, namely the ratio of gross growth in sector 2 to gross growth in sector 1:

$$rg \equiv \frac{1 + g_2}{1 + g_1}$$

where g_i is the rate of growth of output in sector $i = 1, 2$ between two consecutive periods.

When the economy is unconstrained in the two consecutive periods, it follows from Claim 1 that sectoral growth rates are given by:

$$1 + g_i = \left(\frac{\mathbb{E}[G_{t+1}(\omega)]}{\mathbb{E}[G_t(\omega)]} \right)^\alpha$$

Thus, both sectors grow at the same rate, which is a function of the growth rate of aggregate capital. It follows that in this case financial development has no effect on the growth differential.¹²

When the economy is constrained in at least the first of the two consecutive periods, financial development has an effect on the growth differential.¹³ For example, when financial frictions bind in both periods, the growth differential is given by:

$$rg = \left(\frac{1 - x_{t+1}}{x_{t+1}} / \frac{1 - x_t}{x_t} \right)^{1-\alpha} = \left(\frac{\tilde{x}_{t+1}}{\tilde{x}_t} \right)^{1-\alpha} \quad (17)$$

where $\tilde{x}_t \equiv (1 - x_t)/x_t$ is the *relative* mass of agents whose wealth is above the threshold. Along a typical development path, we have $\tilde{x}_{t+1} \geq \tilde{x}_t$, so that the economy exhibits non-balanced growth in favor of sector 2, i.e. $rg \geq 1$, as established in Proposition 1 above. Since both \tilde{x}_{t+1} and \tilde{x}_t increase with λ , the effect of financial development on the growth differential depends on which of these two effects is stronger. The following Proposition deals with this situation.

Proposition 2. (Financial Development, I) Consider an economy that is constrained in both periods $t = 0$ and $t = 1$, with $x_0 \geq x_1$. Define w_1 as

$$w_1 \equiv \frac{\frac{f}{s\lambda} - \pi_1^* - \pi_{FG}^*}{1 + r} \quad (18)$$

where π_1^* , π_{FG}^* and r are profits in sector 1, profits in the final good sector and the interest rate at $t = 0$. Denote by $G(\omega)$ the CDF and by $g(\omega)$ the PDF of the $t = 0$ distribution of wealth. Under

identical wealth, or to a constrained steady state in which the distribution of wealth has mass on two points - a low level of wealth associated with operating in sector 1 and a high level of wealth associated with operating in sector 2. For more details on the steady state, see Section 3.5.5 in the Appendix.

¹²This is because if at the initial λ the economy is unconstrained in both periods, then at the higher λ the economy is still unconstrained in both periods. Thus, for both levels of λ , the growth differential is equal to unity.

¹³Given the focus on a typical development path, I do not consider the case in which the economy switches from unconstrained to constrained.

the following two conditions:

$$\frac{g(w_1)}{G(w_1)(1 - G(w_1))} > \frac{g(f/\lambda)}{G(f/\lambda)(1 - G(f/\lambda))} \quad (19)$$

$$s(1 + r) \leq 1 \quad (20)$$

an increase in λ leads to an increase in rg .

See Appendix for a proof. Proposition 2 establishes sufficient conditions under which financial development leads to an increase in the growth differential. Recall that, from equation (17), the ratio of sectoral growth rates depends on the ratio of relative mass of agents above the threshold at $t = 1$ to relative mass at $t = 0$. First note that financial development decreases the “effective” threshold f/λ , and thus increases the relative mass of agents above the threshold at $t=0$, \tilde{x}_0 . This effect tends to decrease the growth differential, rg . The intuition is that financial development increases entry in sector 2 at $t = 0$, thus increasing output in sector 2 and decreasing output in sector 1 - which for given levels of output in $t = 1$ tends to decrease the growth rate of sector 2 and increase the growth rate of sector 1. However, financial development also affects the equilibrium in period $t = 1$. The decrease in f/λ lowers x_0 , which in turn increases the $t = 0$ interest rate (r), profits in sector 1 (π_1^*) and profits in the final good sector (π_{FG}^*). This implies that more agents cross the wealth threshold between $t = 0$ and $t = 1$, and thus x_1 is lower, or equivalently \tilde{x}_1 is higher (see (3)). In other words, there is entry into sector 2 and exit out of sector 1 at $t = 1$, which implies that output in sector 2 increases and output in sector 1 decreases. Thus, for given levels of output at $t = 0$, the growth differential increases. The combination of these two effects, that is, the effect on $t = 0$ production levels and on $t = 1$ production levels, means that the qualitative effect of financial development on the growth differential depends on parameters. Conditions (19) and (20) guarantee that the effect on $t = 1$ output levels is stronger than the effect on $t = 0$ output levels.

Let’s try to understand the intuition behind these conditions. First note that w_1 , defined in the statement of the proposition, is the level of $t = 0$ wealth below which agents are still constrained in period $t = 1$. Thus, we can express the mass of agents below the threshold at $t = 1$ as a function of the distribution of wealth in $t = 0$ and w_1 , that is $x_1 = G(w_1)$. Thus, x_0 and x_1 are each determined by a wealth threshold, f/λ and w_1 , respectively. The increase in λ reduces x_1 via decreasing w_1 . Condition (19) insures that the distribution of wealth is such that the elasticity of $(1 - G(w))/G(w)$ with respect to w is greater at threshold w_1 than at threshold f/λ .¹⁴ Thus, for *the same reduction in these thresholds*, financial development induces a higher increase in entry at $t = 1$ than there is at $t = 0$, thus increasing rg . In addition to this, condition (20) ensures that the decrease in w_1 is larger than the decrease in f/λ , which further reinforces the increase in the growth differential.¹⁵ The

¹⁴This see this, note that the elasticity of the relative mass of agents above a given point w is given by:

$$\frac{\partial}{\partial w} \left(\frac{1 - G(w)}{G(w)} \right) \frac{G(w)}{1 - G(w)} = \frac{-g(w)}{(1 - G(w))G(w)}$$

¹⁵It should be noted that condition (20) is also required for the existence of an unconstrained steady state. See

intuition can be seen in partial equilibrium. If prices do not change after the increase in λ , we have that $d(f/\lambda) = s(1+r)dw_1$. When $s(1+r) < 1$, a decrease in f/λ induces an even larger decrease in w_1 . This condition holds either when the interest rate is low enough, or when the savings rate is low enough. Since financial frictions depress the equilibrium interest rate, the first case corresponds to sufficiently deteriorated financial institutions (λ low enough).

Finally, it is important to note that condition (19) is satisfied by the Pareto distribution¹⁶, a family that turns out to be a good approximation for the upper tail of the actual distribution of wealth - see PARETO (1897). The uniform distribution also satisfies condition (19), as long as both thresholds are low enough.

I now turn to the case in which the economy is constrained only in the first of the two periods.

Proposition 3. (Financial Development, II) Consider an economy which is constrained in period $t = 0$ and unconstrained in period $t = 1$. In this case, an increase in λ reduces rg .

This proposition follows directly from Claims 1 and 2 which imply that the ratio of growth in sector 2 to growth in sector 1 is given by:

$$rg = \frac{1+g_2}{1+g_1} = \left(\frac{\gamma_2}{\gamma_1} \frac{x_0}{1-x_0} \right)^{1-\alpha} \quad (22)$$

where $x_0 = G_0(f/\lambda)$. Since the economy is constrained in the first period, we have that $x_0 > \gamma_1/(\gamma_1 + \gamma_2)$ which immediately implies $rg > 1$. It follows from equation (22) that financial development, by reducing x_0 , reduces the growth differential. The same is true for any change in the wealth distribution $G_0(\omega)$ that reduces x_0 .

A numerical example can help summarize the results from Propositions 2 and 3. Figure 3 shows the growth differential, rg , as λ increases, when the distribution of wealth in the first period is Pareto¹⁷ and the conditions of Proposition 2 are initially satisfied. For λ low enough, financial development increases the growth differential, as implied by Proposition 2. For intermediate values of λ the economy is still constrained in the first period but is now unconstrained in the second period. As prescribed by Proposition 3, the growth differential falls with financial development in this range. For λ large enough, the economy is unconstrained in both periods and financial development has no effect on the growth differential, which is constant at unity.

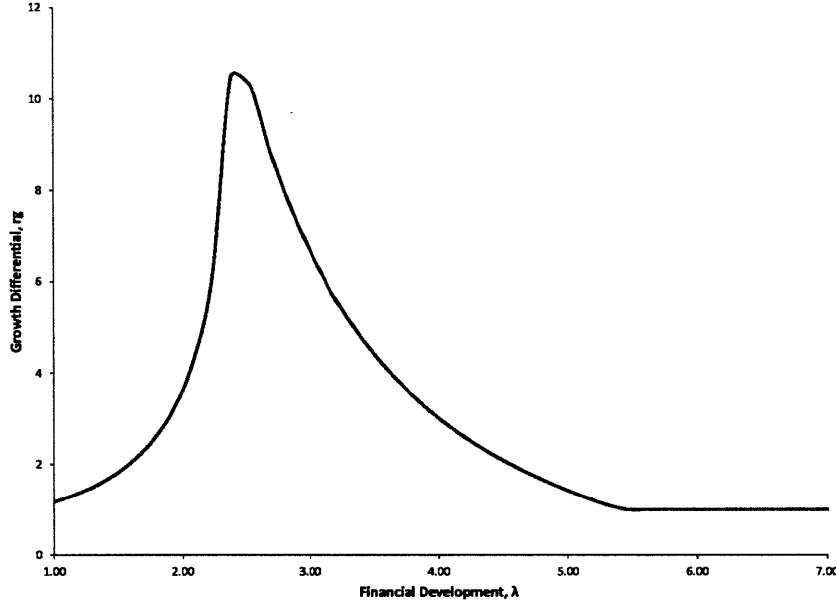
section 3.5.5 in the Appendix.

¹⁶Note that, since $f/\lambda > w_1$, condition (19) can be replaced by a stronger condition:

$$\frac{\partial}{\partial w} \left(\frac{g(w)}{(1-G(w))G(w)} \right) < 0 \quad (21)$$

It is straightforward to verify that the Pareto family satisfies this condition.

¹⁷That is, $G_0(\omega) = 1 - (\omega_{min}/\omega)^\theta$.



Notes: The Figure displays the value of the ratio of growth rates, rg , for each of 40 values of λ in the interval $[1,7]$. The distribution of wealth in the first period is assumed to be Pareto with scale parameter $\omega_{min} = 0.13$ and shape parameter $\theta = 3$. The technological parameters are $\gamma_1 = \gamma_2 = 0.3$, $\alpha = 0.2$, $f = 0.91$, $\delta = 0.058$. The savings rate is $s = 0.89$ and the average capital stock is $E[G_0(\omega)] = 0.2$.

Figure 3: Financial Development and the Growth Differential

3.3.5 Testing Model Implications

The model predicts an inverted U-shaped relation between the degree of excess growth in externally dependent sectors and the level of financial development - see Figure 3. In this subsection, I provide evidence in support of this prediction. Table 4 contains the results of estimating equation (1) for subsamples of low, intermediate and high financial development countries. We see that for low financial development countries the effect of financial development on the growth differential is strong and *positive*. Comparing Table 4 with Table 3, which runs the same specification for the full sample, we see that the coefficients on the subsample of low financial development countries are at least three times larger in magnitude. For countries with an intermediate level of financial development, Table 4 shows a *negative* relationship between financial development and the growth differential, as predicted by the theory. Finally, for sufficiently financially developed countries, Table 4 shows no relationship between financial development and excess growth in externally dependent sectors. In short, the data supports the inverted U-shaped relation between financial development and the growth differential predicted by the theory.

	Low Fin. Dev.		Intermediate Fin. Dev.		High Fin. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)
Ext Dep x Priv Credit	0.0887*		-0.6958*		0.0377	
	(0.0457)		(0.3688)		(0.0316)	
Ext Dep x MktCap		0.2271**		-0.1662*		0.0111
		(0.0976)		(0.1027)		(0.0207)
Country and Sector FE	Y	Y	Y	Y	Y	Y
Observations	579	396	195	182	264	222
R2	0.4183	0.606	0.4869	0.4873	0.605	0.5626

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the annual compounded growth rate in output for the period 1980-1989 for each ISIC industry in each country. The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by Rajan and Zingales (1998). The variable "Priv Credit" stands for the ratio of private credit by deposit money banks and other financial institutions to GDP. "MktCap" stands for the ratio of stock market capitalization to GDP. Both financial development measures are taken from Beck, Demirgüç-Kunt, and Levine (2000). The thresholds to classify countries into the low, intermediate and high financial development groups are the 50th and the 75th percentile of the ratio of private credit (or stock market capitalization) to GDP.

Table 4: Financial Development and Industry Growth: Split Sample

3.4 Concluding Remarks

In this paper, I provide new evidence of non-balanced growth. Using a panel of 69 countries with 15 manufacturing sectors per country for the period 1967-1991, I show that sectors that rely more heavily on external finance feature faster output growth along the economy's development path. I also show that financial development is associated with disproportionately faster growth in industries that are more intensive in external finance. I argue that financial frictions can account for these two facts. I build a two-sector dynamic model where sectors only differ in their liquidity requirements and financial markets are imperfect. In particular, I focus on frictions that affect the ability of agents' to enter one of the sectors but have no effect on intensive margin decisions. In the model, non-balanced growth emerges as a consequence of the frictions in financial markets. I derive conditions under which financial development leads to a disproportionate increase in the growth rate of the externally dependent sector. In general, the model predicts an inverted U-shaped relation between financial development and the degree of excess growth in the externally dependent sector. I show that this prediction is supported by the data.

3.5 Appendix

3.5.1 Countries in the sample

Algeria	Ethiopia	Korea	South Africa
Australia	Fiji	Luxembourg	Spain
Austria	Finland	Malawi	Sri Lanka
Bangladesh	France	Malaysia	Sweden
Barbados	Germany	Malta	Switzerland
Belgium	Ghana	Mexico	Syrian Arab Republic
Bolivia	Greece	Morocco	Trinidad And Tobago
Brazil	Honduras	Netherlands	Tunisia
Canada	Hungary	Norway	Turkey
Chile	India	Panama	United Kingdom
Colombia	Indonesia	Paraguay	United States
Cote D'Ivoire	Iran	Peru	Uruguay
Cyprus	Ireland	Philippines	Venezuela
Denmark	Israel	Poland	Zambia
Dominican Republic	Italy	Portugal	Zimbabwe
Ecuador	Japan	Romania	
Egypt	Jordan	Senegal	
El Salvador	Kenya	Singapore	

Table 5: Countries in UNSD Data

3.5.2 Proof of Claim 1

To prove Claim 1 we need to characterize the unconstrained equilibrium, i.e. the equilibrium in which financial frictions do not bind. In this case, agents can freely move between sectors and therefore profits are equalized across sectors - see condition 2(d)i in the equilibrium definition. This implies that $p_1 A_1 = p_2 A_2$, which together the ratio of equations (6) to (7) imply:

$$\frac{\mu}{1 - \mu} = \frac{\gamma_1}{\gamma_2}$$

or $\mu = \gamma_1 / (\gamma_1 + \gamma_2)$. Profit equalization implies that the capital market clearing condition (5) becomes:

$$k_i = \left(\frac{\alpha A_i p_i}{r + \delta} \right)^{\frac{1}{1-\alpha}} = \mathbb{E}[G(\omega)] \quad (23)$$

Sectoral outputs are then given by:

$$Q_1 = \mu A_1 \mathbb{E}[G(\omega)]^\alpha = \frac{\gamma_1}{\gamma_1 + \gamma_2} A_1 \mathbb{E}[G(\omega)]^\alpha$$

$$Q_2 = (1 - \mu) A_2 \mathbb{E}[G(\omega)]^\alpha = \frac{\gamma_2}{\gamma_1 + \gamma_2} A_2 \mathbb{E}[G(\omega)]^\alpha$$

To show that prices are decreasing in mean wealth, we need to derive expressions for p_1 , p_2 and r . Plugging equation (23) into equation (6), and using the profit equalization condition, we obtain:

$$A_i p_i = \frac{\gamma_1^{\gamma_1} \gamma_2^{\gamma_2} (\gamma_1 + \gamma_2)^{1-\gamma_1-\gamma_2} A_1^{\gamma_1} A_2^{\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}} \quad (24)$$

Plugging (24) back into equation (23), we obtain an expression for the interest rate:

$$r = \alpha \frac{\gamma_1^{\gamma_1} \gamma_2^{\gamma_2} (\gamma_1 + \gamma_2)^{1-\gamma_1-\gamma_2} A_1^{\gamma_1} A_2^{\gamma_2}}{\mathbb{E}[G(\omega)]^{1-\alpha\gamma_1-\alpha\gamma_2}} - \delta$$

Finally, the condition that $\mu \geq x$, i.e. the aggregate financial constraint, remains to be verified. This condition is satisfied whenever:

$$\frac{\gamma_1}{\gamma_1 + \gamma_2} \geq x$$

This concludes the proof. ■

3.5.3 Proof of Claim 2

When $\frac{\gamma_1}{\gamma_1 + \gamma_2} < x$, the allocation derived in the previous subsection cannot be an equilibrium since it violates the aggregate financial constraint that $\mu \geq x$. Instead, the mass of agents in sector 1 is as low as possible, i.e. $\mu = x$. In this case, the capital market clearing condition (5) becomes:

$$x (A_1 p_1)^{\frac{1}{1-\alpha}} + (1-x) (A_2 p_2)^{\frac{1}{1-\alpha}} = \left(\frac{r + \delta}{\alpha} \right)^{\frac{1}{1-\alpha}} \mathbb{E}[G(\omega)] \quad (25)$$

The ratio of equations (6) to (7) pins down the degree to which prices are higher in sector 2:

$$A_2 p_2 = \left(\frac{x}{1-x} \frac{\gamma_2}{\gamma_1} \right)^{1-\alpha} A_1 p_1 \quad (26)$$

Equations (25) and (26) imply:

$$x \left(\frac{\alpha A_1 p_1}{r + \delta} \right)^{\frac{1}{1-\alpha}} = x k_1 = \frac{\gamma_1}{\gamma_1 + \gamma_2} \mathbb{E}[G(\omega)] \quad (27)$$

$$(1-x) \left(\frac{\alpha A_2 p_2}{r + \delta} \right)^{\frac{1}{1-\alpha}} = (1-x) k_2 = \frac{\gamma_2}{\gamma_1 + \gamma_2} \mathbb{E}[G(\omega)]$$

It then follows that sectoral outputs are given by the expressions in (11). Finally, to prove point #4 of Claim 2, we need to derive expressions for p_1 , p_2 , r , π_1^* , π_2^* and π_{FG}^* . Using equations (27), (26) and (6) we obtain:

$$p_1 = \frac{\gamma_1^{1-\alpha(1-\gamma_1)} \gamma_2^{\alpha\gamma_2} (\gamma_1 + \gamma_2)^{\alpha(1-\gamma_1-\gamma_2)} A_2^{\gamma_2} / A_1^{1-\gamma_1}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}} \frac{(1-x)^{(1-\alpha)\gamma_2}}{x^{(1-\alpha)(1-\gamma_1)}}$$

$$\begin{aligned}
p_2 &= \frac{\gamma_1^{\alpha\gamma_1} \gamma_2^{1-\alpha(1-\gamma_2)} (\gamma_1 + \gamma_2)^{\alpha(1-\gamma_1-\gamma_2)} A_1^{\gamma_1} / A_2^{1-\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}} \frac{x^{(1-\alpha)\gamma_1}}{(1-x)^{(1-\alpha)(1-\gamma_2)}} \\
r &= \alpha \frac{A_1^{\gamma_1} A_2^{\gamma_2} x^{(1-\alpha)\gamma_1} (1-x)^{(1-\alpha)\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)+1-\alpha}} (\gamma_1 + \gamma_2)^{\alpha(1-\gamma_1-\gamma_2)+1-\alpha} \gamma_2^{\alpha\gamma_2} \gamma_1^{\alpha\gamma_1} - \delta \\
\pi_1^* &= (1-\alpha) \frac{\gamma_1^{1+\alpha\gamma_1} \gamma_2^{\alpha\gamma_2} A_2^{\gamma_2} A_1^{\gamma_1}}{(\gamma_1 + \gamma_2)^{\alpha(\gamma_1+\gamma_2)}} \frac{(1-x)^{(1-\alpha)\gamma_2}}{x^{1-\gamma_1(1-\alpha)}} \mathbb{E}[G(\omega)]^{\alpha(\gamma_1+\gamma_2)} \\
\pi_{FG}^* &= (1-\gamma_1-\gamma_2) \frac{\gamma_1^{\alpha\gamma_1} \gamma_2^{\alpha\gamma_2}}{(\gamma_1 + \gamma_2)^{\alpha(\gamma_1+\gamma_2)}} A_1^{\gamma_1} A_2^{\gamma_2} x^{\gamma_1(1-\alpha)} (1-x)^{\gamma_2(1-\alpha)} \mathbb{E}[G(\omega)]^{\alpha(\gamma_1+\gamma_2)}
\end{aligned}$$

Note that $x^{\gamma_1}(1-x)^{\gamma_2}$ is decreasing in x for $x > \frac{\gamma_1}{\gamma_1+\gamma_2}$. ■

3.5.4 Proof of Claim 3

When the Lorenz curve lies before the line of perfect equality at point $\omega = f/\lambda$ we have that

$$\frac{\int_{\{\omega < f/\lambda\}} \omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \leq \int_{\{\omega < f/\lambda\}} dG(\omega) = \mu$$

and that

$$\frac{\int_{\{\omega \geq f/\lambda\}} \omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \geq 1 - \mu$$

Then, using condition (16), we have that

$$\frac{1-\mu}{\gamma_2} \leq \frac{1}{\gamma_2} \frac{\int_{\{\omega \geq f/\lambda\}} \omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} < \frac{1}{\gamma_1} \frac{\int_{\{\omega < f/\lambda\}} \omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \leq \frac{\mu}{\gamma_1}$$

which implies condition (10). ■

3.5.5 Steady State

The *unconstrained* steady state is characterized by p_u^{ss} , r_u^{ss} , $\mathbb{E}[G_u^{ss}(\omega)]$ and ω_u^{ss} satisfying equations (5), (6) and

$$\mathbb{E}[G_u^{ss}(\omega)] = \omega_u^{ss} = \frac{s(\pi_1^* + \pi_{FG}^*)}{1 - s(1 + r_u^{ss})}$$

The unconstrained stationary wealth distribution, $G_u^{ss}(\omega)$, is degenerated at $\omega = \omega_u^{ss}$.

The *constrained* steady state is characterized by p_{1c}^{ss} , p_{2c}^{ss} , r_c^{ss} , x_c^{ss} , $\mathbb{E}[G_c^{ss}(\omega)]$, ω_p^{ss} , and ω_r^{ss} satisfying equations (5), (6), (7) and

$$\omega_p^{ss} = \frac{s(\pi_1^* + \pi_{FG}^*)}{1 - s(1 + r_c^{ss})} \text{ and } \omega_r^{ss} = \frac{s(\pi_2^* + \pi_{FG}^*)}{1 - s(1 + r_c^{ss})}$$

$$\mathbb{E}[G_u^{ss}(\omega)] = x_c^{ss} \omega_p^{ss} + (1 - x_c^{ss}) \omega_r^{ss}$$

In the constrained steady state, the stationary distribution of wealth, $G_c^{ss}(\omega)$, has mass x_c^{ss} at $\omega = \omega_p^{ss}$

and mass $1 - x_c^{ss}$ at $\omega = \omega_r^{ss}$. The fact that the economy is constrained in the long run is a consequence of financial frictions together with the presence of a non-convexity. In this regard, the model is close to GALOR AND ZEIRA (1993).

3.5.6 Proof of Proposition 2

Equation (17) implies that we need to study how the change in λ affects the ratio \tilde{x}_1/\tilde{x}_0 . Note first that an increase in λ increases \tilde{x}_0 :

$$\tilde{x}_0 = \frac{1 - G(f/\lambda)}{G(f/\lambda)}$$

As for \tilde{x}_1 , this is the relative mass of agents above the wealth threshold at time $t = 1$. The law of motion of wealth is given by

$$\omega_1 = \begin{cases} s(1+r_0)\omega_0 + s(\pi_{1,0}^* + \pi_{FG,0}^*) & \text{if } \omega_0 < f/\lambda \\ s(1+r_0)\omega_0 + s(\pi_{2,0}^* + \pi_{FG,0}^*) & \text{if } \omega_0 \geq f/\lambda \end{cases}$$

Then it follows that

$$x_1 = Pr(\omega_{t+1} \leq f/\lambda) = Pr(s(1+r_0)\omega_0 + s(\pi_{1,0}^* + \pi_{FG,0}^*) \leq f/\lambda) = G\left(\frac{f/\lambda - s(\pi_{1,0}^* + \pi_{FG,0}^*)}{s(1+r_0)}\right) = G(w_1)$$

is the mass of agents below the threshold in period 1. We can think of w_1 as the threshold level of wealth at time 0, below which all agents will *still* be constrained in period 1. Note crucially that $r_0, \pi_{1,0}^*$ and $\pi_{FG,0}^*$ are all decreasing functions of x_0 , as shown in Claim 3. This means that, by reducing x_0 , the increase in λ also reduces x_1 . Thus, what happens to the ratio of growth rates will depend on which effect, the decrease in x_0 or the decrease in x_1 , is larger. More specifically, the growth differential will increase if $(1 - x_1)/x_1$ increases, in percentage points, by more than $(1 - x_0)/x_0$. Mathematically, we need to take the derivative with respect to λ of the following object

$$rg(\lambda) = \frac{1 - G\left(\frac{f/\lambda - s(\pi_{1,0}^* + \pi_{FG,0}^*)}{s(1+r_0)}\right)}{G\left(\frac{f/\lambda - s(\pi_{1,0}^* + \pi_{FG,0}^*)}{s(1+r_0)}\right)} \frac{G(f/\lambda)}{1 - G(f/\lambda)} \quad (28)$$

where it should be noted that $r_0, \pi_{1,0}^*$ and $\pi_{FG,0}^*$ are all functions of λ (see section 3.5.2 of the Appendix for the explicit functional forms). Differentiating (28) with respect to λ we get

$$\frac{\partial}{\partial \lambda} rg(\lambda) = -\frac{g(w_1)}{G(w_1)^2} \frac{\partial w_1}{\partial \lambda} \frac{G(f/\lambda)}{1 - G(f/\lambda)} - \frac{1 - G(w_1)}{G(w_1)} \frac{g(f/\lambda)}{(1 - G(f/\lambda))^2} \frac{f}{\lambda^2} \quad (29)$$

We need to show that under conditions (19) and (20), this expression is positive. That is,

$$-\frac{g(w_1)}{G(w_1)(1 - G(w_1))} \frac{\partial w_1}{\partial \lambda} - \frac{g(f/\lambda)}{G(f/\lambda)(1 - G(f/\lambda))} \frac{f}{\lambda^2} > 0 \quad (30)$$

Under condition (19), this boils down to showing

$$\frac{\partial w_1}{\partial \lambda} \leq -\frac{f}{\lambda^2} \quad (31)$$

The LHS is

$$\begin{aligned} \frac{\partial w_1}{\partial \lambda} = & -\frac{f}{\lambda^2} \frac{1}{s(1+r_0)} \left\{ 1 + \lambda \frac{r+\delta}{1+r_0} (1-\alpha) \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) \frac{\partial x}{\partial \lambda} \right\} - \dots \\ & - \frac{\left(\pi_{1,0}^* (1-\alpha) \left(\frac{\gamma_1 - \frac{1}{1-\alpha}}{x} - \frac{\gamma_2}{1-x} \right) - \frac{\gamma_2(1-\alpha)}{1-x} \pi_{FG,0}^* \right) \frac{\partial x}{\partial \lambda} (1+r) - \left(\pi_{1,0}^* + \pi_{FG,0}^* \right) (1-\alpha) (r+\delta) \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) \frac{\partial x}{\partial \lambda}}{(1+r_0)^2} \end{aligned} \quad (32)$$

Note that the first term on the RHS of 32 is smaller than or equal to $-f/\lambda^2$, since $s(1+r_0) \leq 1$ by condition (20), and the term in the curly bracket is larger than unity. Thus, it suffices to show that

$$\frac{\left(\pi_{1,0}^* (1-\alpha) \left(\frac{\gamma_1 - \frac{1}{1-\alpha}}{x} - \frac{\gamma_2}{1-x} \right) - \frac{\gamma_2(1-\alpha)}{1-x} \pi_{FG,0}^* \right) \frac{\partial x}{\partial \lambda} (1+r) - \left(\pi_{1,0}^* + \pi_{FG,0}^* \right) (1-\alpha) (r+\delta) \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) \frac{\partial x}{\partial \lambda}}{(1+r_0)^2} \geq 0 \quad (33)$$

Note that this expression's numerator can be written as

$$\begin{aligned} \frac{\partial x}{\partial \lambda} (1-\alpha) \left\{ \pi_{1,0}^* \left[\left(\frac{\gamma_1 - \frac{1}{1-\alpha}}{x} - \frac{\gamma_2}{1-x} \right) (1+r) - \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) (r+\delta) \right] \right. \\ \left. + \pi_{FG,0}^* \left[-\frac{\gamma_2}{1-x} (1+r) - \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) (r+\delta) \right] \right\} \end{aligned} \quad (34)$$

Each of the expressions within the brackets is negative. For the first one, note that

$$\left(\frac{\gamma_1 - \frac{1}{1-\alpha}}{x} - \frac{\gamma_2}{1-x} \right) < \left(\frac{\gamma_1}{x} - \frac{\gamma_2}{1-x} \right) < 0$$

as we have assumed that the equilibrium is constrained and thus $x > \frac{\gamma_1}{\gamma_1 + \gamma_2}$. This means that the expression in the curly bracket is negative, which together with $\frac{\partial x}{\partial \lambda} < 0$ implies that the expression in (34) is positive. This proves (33) and concludes the proof. ■

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